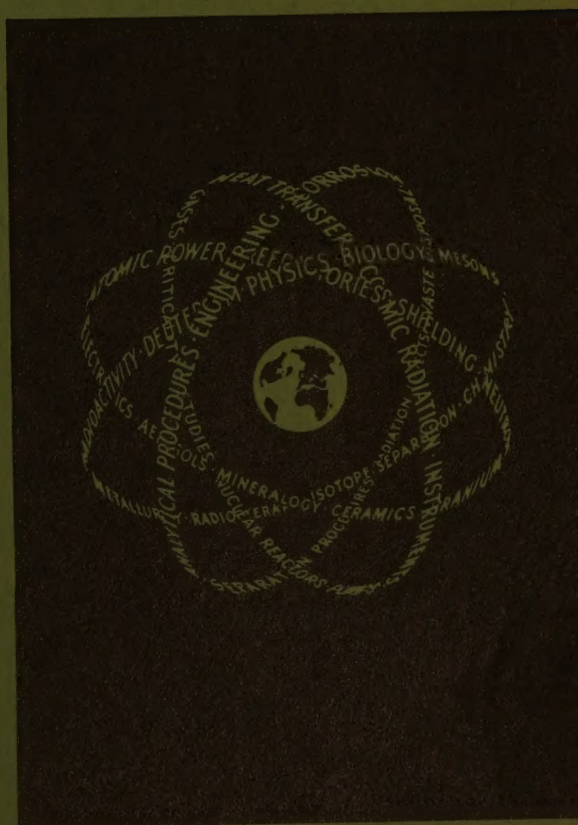
NUCLEAR SCIENCE ABSTRACTS



September 30, 1960

Volume 14 Number 18A
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CONTENTS

Volume 14, Number 18A, September 30, 1960

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NUCLEAR SCIENCE ABSTRACTS

Volume 14 Number 18A September 30, 1960

GENERAL AND MISCELLANEOUS

17640 AD-227637

Frankford Arsenal. Pitman-Dunn Lab., Philadelphia.

BASIC RESEARCH IN COOPERATION WITH THE OFFICE OF ORDNANCE RESEARCH, STATUS REPORT. Seventh Annual Report [for] period: July 1, 1957 to June 30, 1958. July 1958. 56p. DA Project 5B99-01-004. (R-1497).

A comprehensive review is given of the study of visible effects produced in alkali halide single crystals by alpha particle bombardment at very low integrated flux. It is shown that the anomalous regions of birefringence resulting from irradiation may be divided into two classes, based on their appearance in the polarizing microscope. X-ray-diffraction studies of plastically deformed single crystals of several pure materials were made as a preliminary to a study of the role of lattice defects in kinetic processes in metals. Deformations up to about 10% were employed in specimens of aluminum, lead, sodium chloride, and potassium chloride. Thin (10^{-6} cm) films of copper and gold deposited on soft glass and stainless steel substrates were irradiated by gamma rays from a cobalt-60 source. Radiation up to 10^{7} roentgens produced no effect that could be detected by resistivity changes or changes in the x-ray diffraction patterns. A study of the system magnesium-lead-zinc is under way as part of a broad program to deduce general principles of alloy formation and properties from thermodynamic data. Vapor pressure and reversible-electrode potential methods were selected to measure the thermodynamic properties. Preliminary accomplishments are described. The three interactions of an x-ray photon with two phonons in the beta gold-zinc lattice are discussed. The effect of one of these interactions, that between the photon and both an acoustical phonon and an optical phonon, was previously neglected in the calculations on this alloy. An improved frequency spectrum is presented. A specific heat curve of beta gold-zinc, derived from the frequency spectrum and the energy of a quantum-mechanical harmonic oscillator, is shown. The autoxidation of bis(3-methylbutyl) adipate was studied at 100°C in the presence of copper 2-ethyl hexoate as catalyst. It was found that the initial reaction involves an interaction between the meta and the diester. The α-N-carboxy anhydrides of glutamic acid, lysine, and cystine were copolymerized to produce amphoteric polypeptides. Films of these materials exhibit reversible contractile properties expanding in both acidic and alkaline mediums. The preparation of other amino acid derivatives is also described. (auth)

17641 ANL-6122(p.10-22)

Oak Ridge National Lab., Tenn.

BURNING THE ROCKS. Alvin M. Weinberg. p.10-22 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959

The importance of turning to nuclear fission or fusion as an energy source is discussed relative to economics of power generation and the availability of material. Future energy requirements are predicted. (C.J.G.)

17642 BNL-583

Brookhaven National Lab., Upton, N. Y.

NUCLEAR ENGINEERING DEPARTMENT PROGRESS REPORT FOR MAY 1—AUGUST 31, 1959. 80p. OTS.

Reactor Physics. Measurements of anisotropic neutron diffusion in AA graphite were made with improved stack geometry. Thermal utilizations were measured and the migration area computed for the 1.027 and 1.15% enriched 0.25-in.-diam rod lattices. Chemistry and Chemical Engineering. In a large number of gram-scale experiments, the adsorption of Sm from LMFR fuel on graphite was found to be of the order of 1%. It was found that Zr can greatly depress the solubilities of certain of the FPN fission products in Bi. The free energy of formation of ThC_2 was obtained from emf measurements on three different electrochemical cells. Rates of evaporation of Po^{210} in a He atmosphere from Bi containing 1.53×10^{14} atoms of Po^{210} per gram Bi were measured at 500°C and 10 to 100 mm Hg pressure. The adsorption of Xe on ThO_2 particles suspended in Bi was studied. Attempts to disperse ThF_4 in Bi to which Ca, Na, and Al were added as wetting agents did not succeed. The liquid mixture NO_2—HF was found to be a most versatile solvent. It dissolves the following materials at rates sufficient for a reactor fuel processing operation: alpha U, Zircaloy-2, U—Zr alloy, 304SS, 2S Al, Nb, Mo, Be, and ceramic UO_2. The conditions under which U—BrF_3 systems will explode were clarified. The solubility of Kr, N_2, and O_2 in Freon-22 was measured over a wide pressure-temperature range. Studies on the treatment of neutralized wastes and recovery of Cs and Sr by solvent extraction were continued. Ortho-para hydrogen exchange and hydrogen adsorption were measured an irradiated MgO catalysts. Additional experimental heat transfer results were obtained for the case of parallel flow of Hg through staggered tube banks. Hot Laboratory. Calcium phytalocyanine shows promise of being an excellent Szilard-Chalmers target for the production of Ca^{47}. A method of producing high specific activity Cu^{67} from enriched and re-usable Ni^{64} was developed. Metallurgy. The use of Ta foil to getter impurities inhibiting wetting of ThO_2 by Bi is partially successful. (For preceding period see BNL-571.) (W.L.H.)

17643 K-1449

Oak Ridge Gaseous Diffusion Plant, Tenn.

OAK RIDGE GASEOUS DIFFUSION PLANT STAFF PUBLICATIONS 1947—1959. Evelyn Levine Hoey. July 8, 1960. 37p. Contract W-7405-eng-26. OTS.

A compilation of references to publications by Oak Ridge Gaseous Diffusion Plant personnel is presented. Included are all known publications in the book, journal, and patent literature as represented in the Plant Library's card file. Publications in the report literature are not included. (auth)

17644 KAPL-1536

Knolls Atomic Power Lab., Schenectady, N. Y.

REPORT OF THE CHEMISTRY AND CHEMICAL ENGINEERING SECTION FOR FEBRUARY, MARCH, APRIL 1956. Decl. May 3, 1960. 98p. Contract W-31-109-Eng-52. OTS.

Studies were continued on the following: waste treatment by alkaline electrolytic destruction of nitrate; fabrication, dissolution, and solvent extraction of UO_2–PuO_2 fuels; radiochemical properties of Cm and Pu isotopes; preparation and properties of PuF_6; corrosion and particle size measurements of UO_2–NaK slurries; alumina–water equilibria; and electrorefining and electrowinning of U from oxide. (For preceding period see KAPL-1491.) (C.W.H.)

17645 NP-8551

Australia. Atomic Energy Commission.

SEVENTH ANNUAL REPORT. Being the Commission's Report for the Year Ended 30th June 1959. 52p.

The following are reported: the search for uranium, uranium mining and raw materials, the research program, and nuclear power. (W.L.H.)

17646

INSURANCE OF ATOMIC RISKS–A POSITION QUESTION FOR OPERATOR AND SUPPLIER OF REACTORS. M. Scheidwimmer (Bundesministerium für Atomkernenergie und Wasserwirtschaft, Bonn). Atom u. Strom 6, 47-52(1960) May. (In German)

The possible extent of the material liability from the construction and operation of reactor plants is discussed, and the limits of private insurance protection are shown. From these considerations the necessities, type, and scope of a partial federal risk insurance are given. The considerations culminate in the drafting of an international agreement on the control of atomic liability and the covering of atomic risks. (tr-auth)

17647

THE POSITION OF THE PROJECTS FOR NUCLEAR POWER STATIONS IN THE COUNTRIES OF THE EUROPEAN COMMUNITY. H. Schult (Steinkohlen-Elektrizität A. G., Essen, Ger.). Brennstoff-Wärme-Kraft 12, 252-4 (1960) June. (In German)

In the European Community there are about 40 and in the total OEEC-scope about 75 research and experimental reactors. Since over five years are needed for completion of a nuclear power plant, only those now in use or under construction will be available before the winter of 1960-65. Effects of the U. S.–Euratom agreement on Euratom's program are discussed. The nuclear power programs of Germany, Italy, Holland, France, Belgium, and England are discussed, and progress is reported. (M.C.G.)

17648

THOUGHTS ON GERMAN NUCLEAR REACTOR CONSTRUCTION. Fr. Münzinger. Brennstoff-Wärme-Kraft 12, 254(1960) June. (In German)

German nuclear reactor construction is discussed and compared to recent developments in other countries. Economic aspects and construction time are considered. A well-thought-out program is advocated as essential, and it is further suggested that a foreign reactor be used in the first nuclear power plant in Germany. (M.C.G.)

17649

THE INVESTIGATION OF THE INDUSTRIAL ENERGY DEMANDS AND ITS IMPORTANCE IN THE STUDY OF THE ECONOMIC DEVELOPMENT AND USE OF ENERGY. H. F. Mueller and Helmut Schäfer (Technische Hochschule, Karlsruhe, Ger.). Brennstoff-Wärme-Kraft 12, 289(1960) June. (In German)

Considering the different political and economical conceptions and predictions on the development of the European energy economies, importance of the coal problem was discussed. The difficulties which arose in this field constituted a warning which should have lead to the institution of very detailed research into energy consumption so that trends of development of energy demand could be recognized as early as possible. The basic principles of development, of industrial demand, and the special difficulties of its exact determination through macro and micro analysis were discussed. The effects of rationalization and automation were also covered. (auth)

17650

COVERAGE OF THE ATOMIC RISK, A PROBLEM OF VITAL IMPORTANCE FOR OPERATORS AND SUPPLIERS OF REACTORS. M. Scheidwimmer (Bundesministerium für Atomkernenergie und Wasserwirtschaft, Bonn). Brennstoff-Wärme-Kraft 12, 290(1960) June. (In German)

The possible extension of financial liability from the construction and operation of reactor plants and the limits of protection through private insurance was discussed. From this view the necessity, kind, and range of a partial state cover for the risk was derived. The considerations led to the drafting of a supra-national agreement on the control of atom-liability and cover of atom-risk. (auth)

17651

NUCLEAR FIRE AND BRIMSTONE. J. M. Dale and R. C. DeHart (Southwest Research Inst., Birmingham, Ala.). Chem. Eng. Progr. 56, No. 7, 90; 92-3(1960) July.

Two possible ways are discussed for using underground nuclear explosions to mine Frasch-type (salt dome) sulfur deposits. One would be to explode the bomb in the sulfur deposit itself; however, because of sulfur's unusual viscosity curve with a maximum at ~375°F, the sulfur must either be mined immediately after the explosion or allowed to cool off. Limestone associated with the sulfur might be used to produce CO_2 for use as heat transfer fluid or lifting medium. Another way would be to explode the bomb below the deposit and melt the sulfur above by conduction; this would greatly reduce radioactive contamination of the sulfur. Different methods for lifting the melted sulfur are discussed, and a preliminary cost calculation was carried out for a 10-kiloton device in a 200-ft^3, 35 vol.% sulfur deposit at 1500-ft depth, giving a cost of $6 to $8 per long ton of sulfur recovered. (D.L.C.)

17652

NUCLEAR BOMB ALARM SYSTEMS. Key Underground Military Installations are Protected from Surprise Nuclear Attack Damage by Detection and Warning System that Recognizes Nuclear Explosion and Activates Automatic Equipment. John C. Champeny, Thomas E. Petriken, and Sebastian Siciliano (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Electronics 32, 53-5 (1959) May 8.

A description is given of a detection and warning system which recognizes a nuclear explosion. It was devised to aid in the protection of key underground military installations from surprise attack damage. The system is actuated automatically if a nuclear detonation occurs in the imme-

diate vicinity, but does not give location or direction information. (B.O.G.)

17653

LIMITATIONS OF A ROCKET PROPULSION SYSTEM WITH VARIABLE EXHAUST VELOCITY TAKING INTO CONSIDERATION NUCLEAR DATA. Trutz Foelsche (National Aeronautics and Space Administration, Langley Field, Va.). J. Astronaut. Sci. 7, 25-8(1960).

It is shown that, for nuclear physical reasons, an end velocity higher than 0.134c cannot be attained by a rocket using a propulsion system which maximizes the end velocity, at given energy content and end mass, by varying the exhaust velocity or by using propellants with variable combustion heat. (auth)

17654

THE ECONOMIC CONDITION OF NUCLEAR POWER STATION COMPETITION WITH COAL POWER STATIONS. Karel Barabas (State Planning Commission, Prague). Jaderná energie 6, 188-91(1960). (In Czech.)

A quantitative expression for nuclear power economic relations from the point of view of socialistic economy is given. Under certain assumptions mathematical conclusions are made; on their basis it is possible to approach the limiting values of capital and fuel investments necessary for nuclear power station competition with ordinary coal power stations fueled with imported coal. (auth)

17655

TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY, DECEMBER 1958. Trans. Am. Nuclear Soc. 1, No. 2, 179p.(1958) Dec. (a suppl. to Nuclear Sci. and Eng.)

The programs and technical summaries of the papers presented at the 1958 winter meeting of the ANS are presented. Sessions were held on research and test reactors, reactor theory, nuclear properties, safety considerations, international atomic energy developments, Fermi Power Plant, reactor concepts, reactor kinetics, heat transfer and fluid flow, nuclear instrumentation, shielding, engineering equipment and systems, reactor analysis, reprocessing and waste disposal reactor programs, fuel elements, codes and calculational methods, control evaluation, maximum permissible radiation levels, materials, and critical experiments. (W.D.M.)

17656

TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY, 1959 WINTER MEETING, WASHINGTON, D. C., NOVEMBER 4-6, 1959. Trans. Am. Nuclear Soc. 2, No. 2, 248p. (1959) Nov. (a suppl. to Nuclear Sci. and Eng.)

Summaries are given of the technical papers presented at the 1959 winter meeting at Washington. Sessions were held on studies on large optimized power reactors, experimental physics, criticality and lattice theory, review of AEC task force studies, reactor kinetics, metallurgy, critical and exponential experiments, neutron thermalization, operational experience, reactor fuels, in-pile techniques, nuclear properties, codes, reactor concepts, fuel elements, cross sections, shielding, transport theory, reactor analysis, reactor components, long term reactivity and control, core design, chemistry of reactor materials, and instrumentation. (W.D.M.)

17657

TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY, 1960 ANNUAL MEETING, CHICAGO, ILLINOIS, JUNE 13-15, 1960. Frank Ward, ed. Trans. Am. Nuclear Soc. 3, No. 1, 326p.(1960) June.

Summaries are given of the technical papers presented at the annual meeting of the ANS held at Chicago, June 1960. Sessions were held on utilization of new computers, exponential and reactivity experiments, chemistry and processing, reactor plants, codes, critical experiments, fuel cycles, analysis by nuclear methods, controlled fusion, reactor kinetics, reactor fuels, heat transfer and fluid flow, control materials, pulsed neutrons and thermal neutron spectra, control physics and spatial kinetics, fuel handling, isotope applications, reactor analysis, safety, reactor theory, instrumentation, criticality hazards, and reactivity lifetime. (W.D.M.)

17658

COURS SUR LES PHENOMENES LIES À LA RESONANCE MAGNETIQUE. TOME I AND II. 1955-1956. (Course on the Phenomena Associated with Magnetic Resonance. Volumes I and II. 1955-1956). A. Abragam. Paris, Centre de Documantation Universitaire. 407p.

The textbook used in the theoretical course on magnetic resonance held at Saclay is presented in two volumes. The topics discussed are movement of a free spin in a magnetic field, the Bloch phenomenological equations, length of ray in the rigid lattice, fine structure of resonance rays and determination of crystalline structure, spin-lattice relaxation in nuclear resonance, theory of the length of ray in the presence of "movement" of spins, effect of electrons on the resonance of nuclear spins in diamagnetic substances ("chemical" displacement and indirect interactions), and transitory phenomena in nuclear resonance and their application. (J.S.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

17659 TID-6107

Harvard Univ., Boston. Medical School.

A PROGRAM FOR THE STUDY OF TRANSPLANTATION OF BONE MARROW, TISSUES, AND WHOLE ORGANS AND OF RELATED TOPICS IN SURGICAL RESEARCH. Progress Report with Outline of Continuing Work. Francis D. Moore. June 1960. 28p. Contract AT(30-1)-2265. OTS.

Progress is reported in studies on the transplantation of tissues and whole organs in the rabbit, dog, and man. Immunologic and genetic factors involved in homograft rejection were studied. The utilization of cytotoxins, immunologic procedures, and x irradiation in enhancing the acceptance of homografts was investigated. Surgical techniques and metabolic care ancillary to transplantation are discussed. Clinical results are reported for the transplantation of kidneys in human twins. Results are discussed for studies on the transplantation of liver and spleen in dogs, the effects of irradiation on the survival of skin transplants, endocrine gland transplantation, bone marrow transplantation, immunity transfer, methods of organ preservation, hospital infection and immunity, and related studies in surgical research. (C.H.)

17660 UCRL-9205

California. Univ., Berkeley. Lawrence Radiation Lab.

BONE MARROW ACTIVITY IN VITRO UNDER THE INFLUENCE OF ANEMIC SERUM AND HUMAN ERYTHROPOIETIN. James S. Beck. May 6, 1960. 7p. Contract W-7405-eng-48. OTS.

A method is described for observing the uptake of Fe by rat bone marrow cells in vitro. Results of experiments on effects of anemic serum and human erythropoietin are presented with a brief discussion. It is concluded that the differences in uptake of Fe^{59} are the result of isotope dilution. (auth)

17661 UR-566

Rochester, N. Y. Univ. Atomic Energy Project. DISTRIBUTION AND EXCRETION STUDIES IN DOGS EXPOSED TO AN AEROSOL CONTAINING POLONIUM-210. Frank A. Smith, Paul E. Morrow, F. Ray Gibb, R. J. Della Rosa, Louis J. Casarett, James K. Scott, and J. N. Stannard. Jan. 29, 1960. 46p. Contract W-7401-eng-49. OTS.

Deposition of inhaled polonium chloride in the dog resulted in a mean deposition of 64 per cent of the polonium. Following deposition, peak blood concentrations were reached 5 to 15 days after exposure. Approximately 30 days after exposure the individual lung lobes, liver, kidney and pelt each contained 1 to 4 per cent of the dose. Whole-lung contained 31 to 48 per cent of the body burden; the individual lobes and pelt each contained 3 to 15 per cent of the body burden. After 149 days the pelt contained more than 50 per cent of the body burden, principally in the hair follicles. Fifty per cent of the deposited polonium was excreted in 12 days. The principal route of excretion was via the feces. In the interval 28 to 149 days post-exposure, the half time for clearance of the dose from the whole lung was 16 days. Whole-body clearance of the dose was achieved with a half time of 29 days. Removal of the material from the body appeared to be governed chiefly by the rate of removal of the polonium from the lungs. Half time for clearance of the lung burden as a percentage of the body burden was 35 days. Pathological changes seen were minimal. It was suggested that analyses of samples of blood and excreta taken at known intervals after a single, acute exposure to polonium by inhalation may be useful guides to estimations of the initial dose. Equations relating levels of polonium in blood and excreta to initial dose and lung and body burdens were presented. (auth)

17662 AEC-tr-4027

NEW CATALYTIC PROCESSES INVOLVING METAL IONS, ESPECIALLY THE RARE EARTHS. THEIR EFFECT ON CELL PROCESSES. Heinz Trapmann. Translated by S. J. Rimshaw from Arzneimittel-Forsch. 9, 341-6; 403-10(1959). 43p. JCL.

The chemical, physical, and biological effects of rare earths and rare earth compounds are reviewed. Emphasis is placed on applications in catalyzed reactions, especially the ability of rare earths to act catalytically on phosphates and to function as phosphate acceptors. Reactions involved in hydration processes, deamination by rare earth metals, the phosphatic properties of the metals as an aid to analysis, and physiological and toxic effects of rare earths are discussed. (C.H.)

17663 JPRS-2280

PROGRESS IN THE USE OF RADIOISOTOPES IN THE FIELD OF MEDICINE SINCE LIBERATION. Shih-chen Wang and Ken-yao Yeh. Translated from Chung Hua Fang Shê Hsüeh Tsa Chih 7, 327-33(1959). 27p. OTS.

Developments in the utilization of radioisotopes in medical research and clinical medicine in China from 1955 to 1960 are reviewed. (C.H.)

17664 JPRS-2282

COMMUNIST CHINA'S ACHIEVEMENT IN CLINICAL RADIOLOGY DURING THE PAST DECADE. Shao-hsun Wang. Translated from Chung Hua Fu Ch'an K'o Tsa Chih 7, 317-26(1959). 35p. OTS.

Equipment is described which is used in Communist China for clinical radiology. Applications of radiography in the diagnosis of occupational diseases such as silicosis and related pneumoconioses, parasitic diseases, endemic diseases such as arthritis and myocarditis, cardiovascular diseases and congenital heart disease, tuberculosis, neoplasms, and miscellaneous diseases are described. Contrast media and radiographic techniques are described. Therapeutic uses of x rays in the treatment of neoplasms are described. The use of traditional Chinese herb medicine is recommended for the preparation of contrast media such as barium tragacanth mucilage and barium sulfate bletia hyacinthina mucilage. Results are reported from x-ray examinations of the effect of acupuncture on conditions such as esophageal function, gastric function, and motility of the appendix. The effects of acupuncture in the treatment of radiation sickness are also being studied. Good results are reported in the treatment of local skin reactions to radiation with traditional medicines such as methol egg yolk, egg white, four-yellow ointment, honey, and the direct application of the amniotic membrane of the placenta on the ulcerative site. (C.H.)

17665

RESPIRATORY TRACT SCLEROMA TREATMENT WITH STREPTOMYCIN AND X-IRRADIATED BLOOD TRANSFUSION. S. Girbea, I. Bodea, H. Costin, and I. Suceava. Acad. rep. populare Romîne, Baza cercetări stiint. Timisoara, Studii cercetări stiint. Ser. stiinte med. 5, No. 2, 163-8(1958). (In Romanian)

The data on respiratory tract scleroma treatment with streptomycin and transfusion with x-irradiated blood are announced. The treatment showed good results. The characteristic infiltration and cortex disappeared immediately following the first transfusions. (R.V.J.)

17666

CENTRIOLE ADJUNCT, CENTRIOLES, MITOCHONDRIA, AND ERGASTOPLASM IN ORTHOPTERAN SPERMATOGENESIS. AN ELECTRON MICROSCOPE STUDY. J. Brontë Gatenby and T. N. Tahmisian (Argonne National Lab., Ill.). Cellule rec. trav. originaux cytol., histol. biol. gén. 60, 105-34(1959). (In English)

Both mitochondria and Golgi bodies are found in the spermatogonia of the locustid Melanoplus. In the latter the Golgi bodies are sub-spherical spongy masses with vacuoles and canaliculi, lamellae being difficult to see. Just where Golgi bodies lie, the nuclear membrane may be resolved into granules which appear to mingle with the former. Right up to a late stage of spermiogenesis, while the nucleus is still spherical, emissions of granular ergastoplasmic membranes or saccules take place, and these become associated with already existing agranular ergastoplasm. In the gryllid Nemobius the nucleus contains at least three types of included bodies, some are typical nucleoli; others, lamellar structures containing a thread. The Golgi bodies of the spermatocyte are of the lamellated and lateral vacuole type, ten lamellae being usual. In some cases the nuclear membrane can be seen to have a double membrane. There are typical Y-granules (rubrophile granula) and chromatoid bodies of two sorts. One kind is slightly electron-opaque, being a smooth sphere, while the other is a peculiar hollow sphere with a serrated cortical wall; this is densely electron-opaque. These spheres are often ill-formed and have tags of similar material. The function of these chromatoid bodies is unknown. They survive through spermatogenesis and must slough off. In Nemobius, the existing ergastoplasm never appears to be reinforced by extensive nuclear emissions as in the locust, though one doubtful case of this has been seen. In the telophase of the maturation divisions, the ergastoplasm near the equator is aggregated into an hour-glass figure, certainly reticular, with slightly opaque material between the filaments. After a time this figure seems to break down and its components re-distribute themselves partly at least throughout the cytoplasm. About this stage the four or five

dictyosomes of the spermatid begin to coalesce to form the acroblast which then has typically seventeen slightly longer lamellae. The centrioles are two double hollow tubes in the spermatocytes and a single hollow tube in the spermatids. In the secondary spermatocyte, division into proximal and distal parts and outgrowth of the flagellum and end flagellar sac, has already taken place. Exit of the flagellum is by the formation of a cytoplasmic infold. The centriole very rarely occupies a position at the anterior end of the oriented spermatid nucleus. The tail of Nemobius and Dytiscus sperms contains a large elongated centriole adjunct body, which encloses the proximal centriole. This adjunct forms two niches for the reception of the upper ends of the mitochondrial nebenkern. The tail and the nucleus are mainly interconnected by the centriole adjunct, and not by the proximal centriole, which remains unchanged. The centriole adjunct (post-nuclear body of Gatenby et al.) has been traced back to the fusion around the centriole of perhaps nine or ten small granules. The mitochondrial nebenkern is formed directly by the agglutination of the post-telophase spermatid mitochondria. The gryllid Nemobius, and the locustid Melanoplus, exhibit surprising differences in the morphology of their Golgi bodies, and in the amount of their ergastoplasm. But the typical dictyosomes of Melanoplus form a fairly typical acroblast with about seven lamellae as against about seventeen in the acroblast of Nemobius. There is some evidence that the original flagellum, which grows out quickly and which is known to be nonmotile, is a hollow tube, down which the 9 + 1 filaments grow later from the head centriole. (auth)

17667

THE EFFECT OF LIMING SOIL AND OF CHLORINE CONTAINING FERTILIZERS ON IODINE UPTAKE BY PLANTS. M. V. Katalymov and V. M. Churbanova (Pryanishnikov Dolgoprud Agrochemical Station, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1191-3(1960) Apr. 11. (In Russian)

Chlorine-containing fertilizers reduced the uptake of iodine by plants, increasing the iodine deficiency in regions with normally lower iodine content. (R.V.J.)

17668

APPLICATION OF RADIOACTIVE PLANT PROTECTION CHEMICALS FOR ILLUSTRATION AND QUANTITATIVE EVALUATION OF SPRAY DEPOSITS. A. Nordby (Norwegian Inst. of Agricultural Engineering, Vollebekk) and K. Steenberg (Agricultural Coll. of Norway, Vollebekk). J. Agr. Eng. Research 4, 174-80(1959).

A method is reported for studying the distribution of spray chemicals in orchard trees. A fungicide was irradiated in a reactor. By activity measurements, amounts of spray deposit on leaves can be determined quantitatively. Radio-autograms illustrate the distribution on single leaves. Examples are given of the application of this method on Norwegian apple tree varieties. The effect of precipitation after spraying on amount of leaf deposits is shown. (auth)

17669

RECENT PROGRESS IN THE MEDICAL UTILIZATION OF RADIOISOTOPES. Roger Ghys (Université, Laval, Can.). Laval méd. 29, 621-42(1960) May. (In French)

After a brief survey of the history of the knowledge of radioactivity, the principal properties of radioisotopes usable in medicine and the methods of determination are reviewed. Radioisotopes can be used for diagnosis or therapy. For diagnosis, in addition to the now classic utilization of I^{131} in hyperthyroidism, a complete series of methods has been perfected. They permit the in vivo study of perturbations of the electrolyte balance, hematopoiesis, and metabolism by numerous molecules of biological interest. In radiotherapy, in addition to utilization of radioisotopes for endogenous irradiations, cobalt and cesium are used in the construction of high-energy radiotherapeutic apparatus. 37 references. (tr-auth)

17670

BONE MARROW DEPRESSION IN MURINE LEUKAEMIA. James T. Duhig (New England Deaconess Hospital, Boston). Nature 187, 71-2(1960) July 1.

The pathology of bone marrow depression in mice with lymphoma and lymphoid leukemia is discussed. Results are reported from studies which indicate the involvement of both the sex hormone system and a lymphocytosis-stimulating factor. (C.H.)

17671

DISTRIBUTION AND EXCRETION OF RADIOFLUORIDE IN THE HUMAN. Curtis H. Carlson, W. D. Armstrong, and Leon Singer (Univ. of Minnesota, Minneapolis). Proc. Soc. Exptl. Biol. Med. 104, 235-9(1960) June.

One mg fluoride labeled with radiofluoride was ingested by each of 2 adult humans. Observations of renal clearance of fluoride, chloride, and creatinine were made. Fluoride clearance always exceeded chloride clearance by many fold and increased with urine flow, but fluoride clearance was always less than creatinine clearance. Renal tubules in 2 individuals, reabsorbed respectively 51 and 63% of fluoride in the glomerular filtrate which indicates a net process of glomerular filtration with a variable amount of tubular reabsorption. Plasma contained 72% of whole blood radiofluoride and radiofluoride concentration of plasma exceeded that of parotid gland saliva. Measurement of uptake and release of the radioisotope by soft tissues and by the skeleton showed characteristic differences of radiofluoride retention in these tissues. Skeletal tissues retained the isotope but soft tissues lost nearly all their activity within 4 hours after ingestion. (auth)

17672

PHYSICAL CONSIDERATIONS IN THE DESIGN OF FACILITIES FOR THE UNIFORM WHOLE-BODY IRRADIATION OF MAN. Edward W. Webster (Massachusetts General Hospital, Boston). Radiology 75, 19-33(1960) July.

The advantages and disadvantages of various concepts for whole-body irradiation units are discussed. The design criteria of treatment facilities to administer a uniform whole-body irradiation dose are reviewed. Means for the evaluation of the radiation dose received are considered. Three whole-body irradiation units in the United States at present are described. (C.H.)

Biochemistry, Nutrition, and Toxicology

17673

ON THE TRANSMISSION OF Sr-90 BY RAT FEMALES TO THEIR YOUNG. V. G. Kulikova (Inst. of Biology, Urals Section of the Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1433-6(1960) Apr. 21. (In Russian)

The accumulation and transmission of Sr^{90} in the milk of rats and the implanting of the isotope in embryos and progenies in relation to the time of its uptake by female rats are studied. Measurements of Sr^{90} content in three successive generations are tabulated. The results indicate high strontium mobility in organisms of pregnant and especially lactating animals. The uptake of radiostrontium during the intra-abdominal development or during suckling

is retained by growing organisms and are transmitted to future generations. (R.V.J.)

17674

SUPPRESSION OF RADIATION DEPOLYMERIZATION OF DESOXYRIBONUCLEIC ACID BY INHIBITORS OF FREE RADICAL REACTIONS. N. M. Emanuel, K. E. Krugliakova, N. A. Zakharova, and I. I. Sapezhinskiĭ (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1451-3(1960) Apr. 21. (In Russian)

The effectiveness of radical reaction inhibitors on free radical reaction mechanisms in DNA depolymerization was studied by introducing propylgallate into the oxygen-containing system. Introduction of 2 ml of 0.68% inhibitor to 2 ml of 0.085% DNA before irradiation reduced the depth of depolymerization. The admixture of a 10% solution of cysteamine chlorohydrate (with 1.96 ml of 0.2M NaCl) 5 hours after irradiation produced the same effect; however, in the later stages the presence of cysteamine enhances the depolymerization process. Introductions of both propylgallate and cysteamine after irradiation indicate the same reduced depth of depolymerization affected by propylgallate alone, but cysteamine strongly stimulates it. The inhibiting effects of propylgallate confirm the postulation on free radical reaction mechanisms in DNA depolymerization. (R.V.J.)

17675

PHYSICOCHEMICAL EFFECTS OF HIGH-SPEED MIXING ON DEOXYRIBONUCLEIC ACID. Herbert S. Rosenkranz and Aaron Bendich (Sloan-Kettering Inst. for Cancer Research, New York and Cornell Univ. Medical Coll., New York). J. Am. Chem. Soc. 82, 3198-3201(1960) June 20.

Brief high-speed mixing of DNA solutions results in a decrease of the sedimentation coefficient of the sample as well as a narrowing of the distribution of sedimentation coefficients. This is interpreted as being due to scission of those DNA macromolecules above a certain size (S > 26). This behavior is not accompanied by significant denaturation. (auth)

17676

STUDIES ON THE DISCRIMINATION AGAINST STRONTIUM BY BONE GROWN IN VITRO. F. W. Lengemann (New York State Veterinary Coll., Ithaca, N. Y.). J. Biol. Chem. 235, 1859-62(1960) July.

Culturing of embryonic bone in vitro showed that both chick and rat bone could discriminate against strontium in favor of calcium. The ends of the bones showed a lower Sr^{89}/Ca^{45} ratio than the shafts. The degree of selection was not dependent upon the species of origin of the serum used in the medium or upon the age of the bones. Heat-treating of the bones destroyed the ability to select against strontium; for live bone the mechanism functioned at 37° but not at 4° and 25°. Selection occurred at some point after the initial entry of the alkaline earth metals into the bone and was associated with the incorporation of the radioisotopes into a less labile form of bone mineral. Loss of radioactivity from this less labile fraction occurred only with viable bone at 37°. The Sr^{89}/Ca^{45} ratio of the bones relative to the same ratio for the medium as well as the total uptake of radioisotopes could be varied by incorporating enzyme inhibitors into the medium. (auth)

17677

COMPARATIVE FIXATION OF CALCIUM AND STRONTIUM BY SYNTHETIC HYDROXYAPATITE. R. C. Likins, H. G. McCann, A. S. Posner, and D. B. Scott (National Inst. of Dental Research, Bethesda, Md. and National Bureau of Standards, Washington, D. C.). J. Biol. Chem. 235, 2152-6(1960) July.

Samples of hydroxyapatite with differing crystal sizes were prepared from solutions containing labeled calcium and strontium. Analysis of these preparations and the results of digestion studies showed a discrimination against strontium in crystal formation which was related to the rate of crystal growth. The discrimination was greater in the slowly grown, larger crystals than in the smaller, rapidly formed crystals. (auth)

17678

TRANSFER OF DIETARY NONRADIOACTIVE STRONTIUM FROM HEN TO CHICK. Clarence L. Grant, Richard C. Ringrose, and Raymond Downer (Univ. of New Hampshire, Durham). J. Biol. Chem. 235, 2157-9(1960) July.

The ash of egg shells from White Leghorn hens fed ration contains 0.049 ± 0.020% strontium and the ash of bones of chicks contains 0.040 ± 0.012%. When these hens are fed the same breeder ration with 0.2% strontium added, the concentration of strontium in the ash of the egg shells increases by a factor of 40 to 50 within 3 days, but no further increase occurs after that time. During the post-treatment period, the hens release some of the body stores of strontium to the eggs. After 50 days, the strontium content of the eggs decreases to approximately 2.5 times the natural level. Chicks hatched from eggs containing large amounts of strontium are able to metabolize appreciable amounts of this element. However, the strontium content of the ash of chick bones decreases to the natural level in 2 months or less because of elimination and dilution caused by rapid growth. Strontium to calcium ratios, calculated from approximate calcium percentages, indicate that there is no discrimination against strontium between the feed and the hen's eggs. The chick embryo shows some selectivity for strontium relative to calcium. (auth)

Fallout and Ecology

17679 TID-6169

Arizona. Agricultural Experiment Station, Tucson. UTILIZATION OF PHOSPHORUS FROM BIOLOGICAL MATERIALS AND THE UPTAKE OF RADIOSTRONTIUM AND RADIOCALCIUM BY VARIOUS TYPE CROPS. Technical Progress Report. [1960?]. 18p. Contract AT(11-1)-103. OTS.

Results are reported from a tracer study of the various factors affecting the utilization of phosphorus from biological materials by plants and the uptake of radiostrontium and radiocalcium by various types of crops. (C.H.)

17680

BIOLOGICAL EFFECTS OF RADIOACTIVE CARBON. Ferdinand Heřčík (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Jaderná energie 6, 181-3 (1960). (In Czech.)

Studies of fall-out effects due to radioactive carbon from nuclear weapon tests put fall-out research in a new light. Radioactive carbon (C^{14}) desintegrates in an unusually long period and it can cause harmful effects in future generations. Some considerations and calculations of its influence caused by ionization and transmutation to radioactive nitrogen are presented. (auth)

17681

AN ASSESSMENT OF THE QUANTITIES OF FISSION PRODUCTS LIKELY TO BE FOUND IN MILK IN THE EVENT OF AERIAL CONTAMINATION OF AGRICULTURAL LAND. R. J. Garner (Agricultural Research

Council Field Station, Compton, Berks, Eng.). Nature 186, 1063-4(1960) June 25.

Evidence is reviewed that the most wide-spread hazard which could result from the deposition of fission products on agricultural land would be the contamination of milk with the isotopes of iodine and strontium. The contributions of barium-140 and cesium-137 to this hazard are also discussed. Experimental data are used as a basis for estimating the maximum level of contamination in milk likely to be encountered. Data are tabulated. (C.H.)

17682

SECRETION OF DIETARY STRONTIUM 90 AND CALCIUM IN HUMAN MILK. S. Allan Lough, Gerald H. Hamada, and C. L. Comar (U. S. Atomic Energy Commission, New York and Cornell Univ., Ithaca, N. Y.). Proc. Soc. Exptl. Biol. Med. 104, 194-8(1960) June.

In 4 out of 5 normal healthy women Sr^{90}/Ca ratio in milk ranged from 0.085 to 0.13 of diet with average 0.10. These values are essentially the same as reported for lactating animals. The value for the other subject was 0.028, and it is considered most likely that this was a result of relatively low calcium intake which probably led to marked negative calcium balance and thus invalidated the procedure. If we assume relationship between Sr/Ca ratio in blood and milk is the same for the human as for cow and goat, it can be calculated that Sr/Ca ratio in these subjects would be about 0.25 that in diet consumed. This value is in agreement with other values obtained for man by methods based on other assumptions. (auth)

17683

AVIAN UPTAKE OF FISSION PRODUCTS FROM AN AREA CONTAMINATED BY LOW-LEVEL ATOMIC WASTES. William K. Willard (Univ. of Georgia, Athens). Science 132, 148-50(1960) July 15.

Birds living on the Oak Ridge White Oak Lake bed, an area contaminated by low-level atomic wastes, revealed a striking seasonal difference in uptake of fission products. Because the omnivorous diet of passerine birds is ecologically comparable to the mixed diet of man, uptake of radionuclides by wild birds provides an assay of amounts to be expected at the trophic level of primary interest to man. (auth)

17684

CONTRIBUTION OF HARDTACK DEBRIS TO CONTAMINATION OF THE AIR DURING 1959. L. B. Lockhart, Jr., R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black (U. S. Naval Research Lab., Washington, D. C.). Science 132, 154(1960) July 15.

A comparison of the concentrations of tungsten-185 and strontium-90 in the air at various times after the 1958 U. S. nuclear tests in the Pacific indicates that debris from this test series contributed less than 10% of the total Sr^{90} content of the ground-level air at Miami and Washington during the spring of 1959. (auth)

17685

PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER–13 SEPTEMBER 1958. VOLUME 33. INDEX OF THE PROCEEDINGS. Geneva, United Nations, 1958. 204p. $16.50.

This volume contains the subject, numerical, and author indexes to the 2,100 papers contained in the thirty-two preceding volumes on the Second International Conference on the Peaceful Uses of Atomic Energy at Geneva, September 1958. (M.C.G.)

Radiation Effects on Living Tissues

17686 A/AC.82/G/R.193

[Egypt. Atomic Energy Commission, Cairo].

SOME SOMATIC CHANGES OBSERVED IN CULEX MOLESTUS FORSKAL 1775. R. O. Darwish, F. A. Abdel Salam, and K. A. Mahmoud. Mar. 13, 1958. 9p.

A study on Culex molestus, placed in solutions containing phosphorus-32 while in the larvae or pupae stage, showed that radiation is detrimental to the life span, sex organs, and reproduction rate of mosquitoes. (C.H.)

17687 AD-227676

California. Univ., Davis.

STUDIES ON PHYSICAL AND CHEMICAL MODIFICATION OF PROTEINS FOR THE PREVENTION OF IRRADIATION OFF-FLAVORS IN MEAT. Report No. 2 (Progress) [for] Period: September 15, 1958–February 15, 1959. A. L. Tappel. 15p. Project 7-84-01-002. Contract DA19-129-qm-1172.

Results are reported from experiments on the reaction of irradiated egg albumin with fluorodinitrobenzene, infrared spectra, carbonyl determinations on separated fractions, and amide nitrogen formation. Further results are presented from studies on the irradiation of tocopherol. (auth)

17688 AF-SAM-60-28

Chicago. Univ. Air Force Radiation Lab. and Chicago. Univ.

EFFECT OF X-IRRADIATION ON SPLEEN NUCLEOTIDE LEVELS. Edwin M. Uyeki. Sept. 23, 1959. 12p.

A study was made of the effects of whole-body x irradiation on the adenosine nucleotide levels of the spleens of rats, mice, and guinea pigs. At various intervals after the animals were exposed to 400 and 800 r of x ray, they were sacrificed and measurements taken of the adenosine triphosphate, adenosine diphosphate, and adenylic acid levels. A lethal dose of x ray (800 r) caused a decrease in the ATP levels of rat spleen to 63 percent below normal and a reduction in the total nucleotide content of the spleen. A 50 percent decrease in the adenosine triphosphate levels of the spleens of mice was observed with 400 r of x ray and after 800 r a progressive and continuous decline in this nucleotide occurred during the survival period. The adenosine triphosphate levels of guinea pig spleens decreased more slowly and to a lesser extent than such levels in the spleens of rats and mice. The radiation-induced decreases in adenosine triphosphate content of the spleens of these three species may be explainable on the basis of an increased adenosine triphosphatase activity which was previously observed in this laboratory to be caused by ionizing radiations. The nature of the biologic test system (viz, growing cells) restricts a casual association between the nucleotide titers and phosphatase activity. (auth)

17689 AF-SAM-60-40

School of Aviation Medicine, Brooks AFB, Tex. and Texas. Univ., Austin. Radiobiological Lab.

RADIOPROTECTION OF FEMALE RATS WITH AET. George S. Melville, Jr. and Thomas P. Leffingwell. Nov. 10, 1959. 15p.

The protective effect of S,2-aminoethylisothiuronium dibromide (AET) against the injury caused by gamma rays was studied in the female rat. Significant protection was achieved using either intraperitoneal injection or gavage. The drug was somewhat more effective when given by the parenteral rather than by the oral route. It was also noted that as the dose rate was decreased from approximately 1,000 to 500 to 100 r per minute, the protective effect of

oral treatment with AET was also decreased. Further evidence suggests that larger animals are more susceptible to the toxic effects of the protective drug itself. (auth)

17690 ORO-280
Longwood Coll., Farmville, Va.
THE EFFECTS OF RADIATIONS AND CHEMICAL TREATMENT ON GROWTH IN PHLEUM PRATENSE ROOTS. Progress Report. Robert T. Brumfield. [1960?]. 17p. Contract AT(40-1)-1676. OTS.

Progress is reported in studies of the effects of ultraviolet radiation, x radiation, and various chemicals on the growth of seedling root tips. The stimulatory effect of ultraviolet radiation was transferred from an irradiated root to a nonirradiated one. Results are illustrated photographically. (C.H.)

17691 ORO-281
Longwood Coll., Farmville, Va.
THE EFFECTS OF RADIATIONS AND CHEMICAL TREATMENT ON GROWTH IN PHLEUM PRATENSE ROOTS. Progress Report. Robert T. Brumfield. [1960?]. 25p. Contract AT(40-1)-1676. OTS.

Progress is reported in studies on the effects of ultraviolet radiation, x radiation, and various chemicals on the growth of seedling root tips. Results are illustrated photographically. (C.H.)

17692 ORO-282
Oklahoma. Univ., Norman. Research Inst.
THE CYTOLOGY AND GENETICS OF RADIATION RESISTANCE IN BACTERIA. Progress Report for the Period of February 1, 1955 to November 1, 1955. 50p. Contract AT(40-1)-1976. OTS.

Cytological observations on Nocardia corallina indicated a haploid mycelial phase and a diploid coccoidal phase of growth. Dose-survivor curves of the coccoids were sigmoidal in shape, which can be interpreted as being indicative of a diploid organism. Because of this evidence of diploidy, the organism was used as a test organism to investigate the unpaired defect theory of Tobias. It was found that successive irradiation of the culture resulted first in increased sensitivity and an exponential dose-survivor response as unpaired defects accumulated. Further successive irradiation caused increased resistance and experiments indicated that this was due to selection for a normally resistant cell present in the parent culture. Preliminary cytological investigations were carried out on each culture, and the only observable change was that the cells became smaller as resistance increased. A comparison of x-ray and ultraviolet light effects indicated that the first effect of both is the same in the cell although the mechanisms apparently differ. In the case of ultraviolet light, evidence is being accumulated which shows both a direct and an indirect effect on direct irradiation. It was found that the haploid phase of Micrococcus aureus maintained a constant dose-survivor response on successive irradiation. This is additional validation of the unpaired defect theory. Preliminary radiobiological investigations were carried out on the "het" strain of Escherichia coli K-12 and a copper resistant Escherichia coli B. Results of these experiments were inconclusive. (auth)

17693 ORO-283
Oklahoma. Univ., Norman. Research Inst.
THE CYTOLOGY AND GENETICS OF RADIATION RESISTANCE IN BACTERIA. Progress Report for the Period of November 1, 1955 to November 1, 1956. 49p. Contract AT(40-1)-1976. OTS.

Cytogenetic procedures, applicable to microbiology, were selected and tested on a suitable organism as a basis for the valid application of these procedures to other microorganisms. Nocardia corallina was chosen as a test organism on the basis of preliminary cytological studies. The crystal violet nuclear stain, the thionin-SO_2 nuclear stain, the crystal violet-tannic acid-congo red cell wall stain, and phase microscopy, were found to be valid tools of microbial cytology if interpreted with restraint. The correlation of cytological and radiobiological findings demonstrated that, in N. corallina, a diploid coccoidal stage, gives rise to a coenocytic diploid hyphal stage which fragments through a nuclear reduction division to form haploid dinucleated bacillary cells. The bacillary cell nuclei fuse and the cell divides to form diploid coccoids. The haploid chromosome number is suggested as three for this organism. It has been demonstrated that a microbial cytogenetic approach involving the correlation and integration of cytological procedures with genetic and radiobiological methods can aid in solving basic problems of microbial cytology and genetics. (For preceding period see ORO-282.) (auth)

17694 ORO-284
Oklahoma. Univ., Norman. Research Inst.
THE CYTOLOGY AND GENETICS OF RADIATION RESISTANCE IN BACTERIA. Progress Report for the Period of November 1, 1956 to November 1, 1957. 44p. Contract AT(40-1)-1976. OTS.

The effects of various chemical mutagens on the radiosensitivity of Nocardia corallina were investigated. The application of the unpaired defect theory of Tobias and the ploidy state in N. corallina were also studied. Nocardia corallina was used as a diploid cell and Micrococcus aureus and Escherichia coli were used as haploid cells for comparative purposes. Chemicals used included nitrogen mustard, sodium azide, copper sulfate, caffeine, ascorbic acid, mercuric chloride, manganous chloride, and hydrogen peroxide. Data are tabulated on the effects of pretreatment with the chemicals on response to ultraviolet and x radiations. Results are also included from a study of the effects of ultraviolet radiation on the cytology and colony development of Nocardia corallina. The effects of pigment on radiosensitivity and factors involved in the development of radiation-resistant strains are discussed. (For preceding period see ORO-283.) (C.H.)

17695 ORO-285
Oklahoma. Univ., Norman. Research Inst.
THE CYTOLOGY AND GENETICS OF RADIATION RESISTANCE IN BACTERIA. Progress Report for the Period of November 1, 1957 to November 1, 1958. 31p. Contract AT(40-1)-1976. OTS.

Progress is reported in studies on the effects of chemical mutagens on the radiation response of bacteria. A search was made for a suitable genetic marker for use as an index of mutagenic activity in Nocardia corallina. Data are included from studies of the effect of visible light on Nocardia corallina, photoreactivation studies on Nocardia corallina, and direct microscopic examination of irradiation damage in Nocardia corallina suspensions. Irradiation techniques were evaluated. Preliminary work with several Azotobacter species showed that the successful use of this organism in the planned experimental approach would necessitate the attainment of a synchronized life cycle. (For preceding period see ORO-284.) (C.H.)

17696 USNRDL-TR-420
Naval Radiological Defense Lab., San Francisco.
ISLET CELL TUMORS OF THE PANCREAS IN THE IRRADIATED AND NON-IRRADIATED RAT. V. J. Rosen,

T. J. Castanera, D. C. Jones, and D. J. Kimeldorf. May 16, 1960. 22p.

During a study of the long-term effects of ionizing radiation on the rat a large number of animals with pancreatic neoplasms was found. Morphologically, the tumors resemble giant islets of Langerhans and were composed predominantly of beta cells. Approximately half of the tumors showed some degree of capsular invasion. The incidence of pancreatic islet cell tumors among non-irradiated control animals was 9.8%, whereas the average incidence in animals from the same litters but subjected to total-body x irradiation with doses of 430 or 680 rads was 18%. The incidence of this tumor in either control or irradiated groups is higher than that reported in any previous reference in the literature. The problem of histogenesis and possible relationships to other endocrine tumors are discussed. (auth)

17697 AEC-tr-3740

COLLECTED WORKS ON RADIOBIOLOGY. (A translation of "Sbornik Rabot po Radiobiologii." N. I. Nuzhdin, ed. A publication of the Publishing House of the Academy of Sciences, U.S.S.R., Moscow, 1955). 162p. OTS.

Separate abstracts have been prepared on seven papers covering various phases of the effects of radiation on mammals. (C.H.)

17698 AEC-tr-3740(p.1-12)

THE EFFECT OF DIFFERENT DOSAGES OF X-RAY IRRADIATIONS ON THE SURVIVAL OF MICE. N. I. Shapiro and N. I. Nuzhdin. p.1-12 of "Collected Works on Radiobiology."

Results are reported from a study of the characteristics of a large number of biological reactions induced in mice as a result of whole-body irradiation. The correlation between the death rate and amount of exposure was determined. Systematic observations were also made on the course of radiation injury in the animals. Results are tabulated. (C.H.)

17699 AEC-tr-3740(p.13-47)

THE ACTION OF ESTROGENS ON THE RADIATION REACTION IN MICE. N. I. Shapiro, N. I. Nuzhdin, and A. M. Kuzin. p.13-47 of "Collected Works on Radiobiology."

Results are reported from a study of the protective action of estrogens against radiation injuries in mice. Data are tabulated on the effects of diethylstilbestrol and synestrol on radiation mortality in mice. Results indicate a protective effect. Possible reaction mechanisms involved are discussed. (C.H.)

17700 AEC-tr-3740(p.48-55)

THE ROLE OF THE PHYSIOLOGICAL STATE OF THE ORGANISM ON UTILIZATION OF PROTECTIVE REMEDIES AGAINST THE DAMAGING ACTION OF PENETRATING RADIATIONS. N. I. Shapiro, A. M. Kuzin, and N. I. Nuzhdin. p.48-55 of "Collected Works on Radiobiology."

Results are reported from a study of the effects of the physiological state of the organism on response to substances which afford protection against radiation injuries. It is concluded that the effectiveness of many protective remedies will depend upon the physiological characteristics of the animals undergoing exposure. Data are tabulated on the effects of a prophylactic administration of diethylstilbestrol on the survival rate of female and male mice exposed to various doses of x radiation. (C.H.)

17701 AEC-tr-3740(p.56-81)

CONCERNING THE ROLE OF DAMAGE TO HEMATOPOIETIC ORGANS IN THE COURSE OF RADIATION REACTION. N. I. Shapiro, N. I. Nuzhdin, M. V. Volkovich, and E. (Ye.) N. Kolodiĭ (Kolodiy). p.56-81 of "Collected Works on Radiobiology."

The protection of hematopoietic tissues in spleen and bone marrow during irradiation increased the rate of survival of mice subjected to whole-body x irradiation. A method is described for spleen transplantation from young mice to their mothers. Histological analysis of the transplanted spleens showed normal hematopoietic function. Transplantation of spleen from nonirradiated animals increased the rate of survival of irradiated animals. Intravenous administration of bone marrow of nonirradiated mice to irradiated mice also increased the rate of survival. Possible reaction mechanisms involved are discussed. (C.H.)

17702 AEC-tr-3740(p.82-110)

STERILIZING ACTION OF IONIZING RADIATION ON MAMMALS. COMMUNICATION I. EFFECT OF X-RAY IRRADIATION ON THE FERTILITY OF MALE MICE. N. I. Nuzhdin, N. I. Shapiro, and O. N. Petrova. p.82-110 of "Collected Works on Radiobiology."

Results are reported from a study of the effects of sterilizing doses of x radiation on the fertility of male mice. The sterilizing effects of x radiation on the males were evaluated from the results of their mating with nonirradiated females. Data are tabulated. (C.H.)

17703 AEC-tr-3740(p.111-47)

STERILIZING ACTION OF IONIZING RADIATION ON MAMMALS. COMMUNICATION II. EFFECTS OF X-RAY AND GAMMA IRRADIATIONS ON THE OESTROUS CYCLE OF FEMALE MICE. N. I. Nuzhdin, N. I. Shapiro, O. N. Petrova, and O. N. Kitaeva (Kitayeva). p.111-47 of "Collected Works on Radiobiology."

Results are reported from a study of the effects of radiation on the estrus cycle in female mice. Vaginal smears were examined daily for three months following exposure of the animals to single irradiation exposure of various doses. The females were mated with nonirradiated males, and all instances of pregnancy and birth were recorded. Data are tabulated on the frequency of occurrence of mean duration of individual stages of the estrus cycle in animals at different time intervals following exposure at various dosages. The effects of strain and physiological condition at the time of exposure and the effects of chronic gamma exposure on the estrus cycle were also investigated and data are included. (C.H.)

17704 AEC-tr-3740(p.148-57)

STERILIZING ACTION OF IONIZING RADIATION ON MAMMALS. COMMUNICATION III. HEREDITARY NATURE OF STERILITY INDUCED BY THE ACTION OF X-RAY IRRADIATION. N. I. Nuzhdin, N. I. Shapiro, O. N. Petrova, and I. A. Nechaev (Nechayev). p.148-57 of "Collected Works on Radiobiology."

Results are reported from a study of the fertility of male mice resulting from the mating of nonirradiated females with irradiated males. Mating capability of the males did not differ from that of controls, but the number of offspring was appreciably decreased. Data are tabulated. (C.H.)

17705 JPRS-2400

MEDICAL RADIOLOGY. Translation of Selected Articles in Meditsinskaya Radiologiya, Vol. 4, No. 2. (1959). 90p. OTS.

17706 JPRS-2400(p.1-10)

CHANGES IN ARTERIAL PRESSURE IN IRRADIATED ANIMALS UNDER ETHER AND HEXENAL ANESTHESIA. E. (A.) F. Leonova. Translated from Med. Radiol. 4, No. 2, 3-10(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14180.

17707 JPRS-2400(p.11-25)

THE INFLUENCE OF SINGLE AND PROLONGED ACCESS TO THE RAT ORGANISM OF RADIOACTIVE STRONTIUM THROUGH THE GASTROINTESTINAL TRACT. L. N. Budko and V. N. Strel'tsova. Translated from Med. Radiol. 4, No. 2, 20-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14182.

17708 JPRS-2400(p.58-64)

THE REACTION OF THE HEMATOPOIETIC ORGANS OF IRRADIATED ANIMALS TO SURGICAL INTERVENTION. N. I. Shmeleva. Translated from Med. Radiol. 4, No. 2, 55-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14188.

17709 NP-tr-419

ON THE LOCAL AND GENERAL EFFECT OF X-RAYS ON THE BONE MARROW OF ALBINO MICE. N. F. Barakina. Translated by A. Schoenfeld (U.K.A.E.A. Atomic Energy Research Establishment) from Zhur. Obscheĭ Biol. 20, 230-8(1959). 17p. JCL or LC.

Results are reported from a study of the effects of x radiation on the morphology of bone marrow cells in mice. The animals were exposed to doses of 700 r as whole-body radiation, whole-body exposure with screening of the left hind limb, and irradiation of one limb with screening of the remainder of the body. Results of histological analysis and quantitative calculation of the various types of cellular elements in the bone marrow were compared. No essential differences in the picture of bone marrow lesion were observed under local and whole-body irradiation during the first three days after irradiation. After the third day characteristic pathological changes were noted. These changes are described. (C.H.)

17710

THE IRRADIATION OF THE CENTRAL NERVOUS SYSTEM OF RATS WITH 900-MEV ALPHA PARTICLES OF THE 184-INCH CYCLOTRON IN BERKELEY, CALIFORNIA. Georg Tisljar-Lentulis. Acta Phys. Austriaca 13, 318-20(1960). (In German)

The alpha irradiation of the complete brain, including the medulla oblongata, of rats was investigated using 900-Mev particles. The instrumentation used in the measurement of the brain activity is described. The results showed that the brain wave activity ceases in the vicinity of 100,000 rad. The heart beat decreases from the normal of 7/sec to 2/sec. The respiration is rapid and heavy. After exposure to another 10,000 to 20,000 rad, breathing stops. A further 10,000 to 20,000 rad causes death. Two basically different types of variations of the brain wave diagrams were established with increasing radionecrosis. One is a continuous decrease of the amplitude with constant frequency distribution. In the other case a distinct maximum of the amplitude occurs at 30,000 to 50,000 rad, in which the number of observed frequencies and the frequency itself strongly decreases. Convulsions did not occur, possibly because of the deep narcosis. The same phenomena occurred in leucotomy as in the irradiated half of the brain. (J.S.R.)

17711

IRRADIATION AND DNA SYNTHESIS IN THREE MOUSE ASCITES TUMOURS. N. R. Ringertz (Karolinska Institutet, Stockholm). Acta Unio Intern. contra Cancrum 16, 1153-6 (1960) (In English)

Data are presented from a study of the effects of irradiation on the synthesis of desoxyribonucleic acid in mouse ascites tumor cells. Cytochemical measurements were made on the individual cells in the population. (C.H.)

17712

TREATMENT OF MOUSE LEUKEMIA WITH HEAVY X-IRRADIATION FOLLOWED BY SPLEEN TRANSPLANTATION. Morten Simonsen, Julius Engelbreth-Holm, Emmerik Jensen, and Hemming Poulsen (University Inst. of Pathological Anatomy, Copenhagen). Acta Unio Intern. contra Cancrum 16, 1179-83(1960). (In English)

Attempts have been made to cure carcinogen-induced leukemia in mice by a supralethal dose of x rays on the whole-body and followed by transplantation of isologous spleen cells. Of 16 leukemic mice treated with 1200 r before large lymphomas had developed, 6 died from the irradiation, 8 died from leukemic relapse, and 2 are still alive without leukemia after 7 and 4 months, respectively. Other experiments are in progress with the aim of treating acute, otherwise lethal irradiation disease with homologous cells. Results are reported which correlate the protective effect of different homologous spleen cells with the graft versus host assay of histocompatibility. (auth)

17713

SOME RECENT LABORATORY STUDIES OF CHEMICAL RADIOSENSITIZERS. J. S. Mitchell, I. Simon-Reuss, and E. A. King (Addenbrooke's Hospital, Cambridge, Eng.). Acta Unio Intern. contra Cancrum 16, 1201-13(1960). (In English)

Results are reported from a survey of chemical radiosensitizers. Particular attention has been directed to the development of quantitative methods of study of the potentiation of the effects of x rays. In the investigations of the inhibition of mitosis in chick fibroblasts in culture, the potentiation factor is defined, and measurements of its value are given for a series of compounds. The relationship between chemical constitution and the activities measured in the biological experiments and clinical trials is discussed for a series of compounds. (auth)

17714

ON THE ENHANCEMENT OF THE CYTOTOXIC EFFECT OF X-RAYS ON EHRLICH ASCITES CARCINOMA. F. Seelich, M. Pantlitschko, and H. Ehrenreich (Universität, Vienna). Acta Unio Intern. contra Cancrum 16, 1214-15(1960). (In English)

The cytotoxic action of x rays on mouse Ehrlich ascites carcinoma cells was increased by the addition of hematoporphyrin. Possible reaction mechanisms involved are discussed. (C.H.)

17715

FRACTIONATED X-IRRADIATION OF THE MAMMALIAN EMBRYO AND CONGENITAL ANOMALIES. Roberts Rugh and Erika Grupp (Columbia Univ., New York). Am. J. Roentgenol., Radium Therapy Nuclear Med. 84, 125-44 (1960) July.

Pure strain CF_1 Swiss white mice were time-mated to provide 387 dated pregnancies resulting in 3,598 implantations. These were x-irradiated to 25 r twice during the embryonic period from 0.5 to 8.5 days after conception in order to test the effect of 50 r fractionated x irradiation on the early mammalian embryo. There were 36 combinations of the fractionated exposures within this period, in none of which were less than 54 implantations studied. The results following 50 r single exposure of the early embryo or 50 r fractionated into two equal exposures at least 24 hours and

up to 7.5 days apart did not differ from each other with respect to resorptions, or total percentage which appeared to be normal. However, with fractionation there were fewer exencephalies, or brain hernias, and also fewer fetal deaths. While exencephaly did not occur frequently after 50 r x irradiation, it did occur in litters which had been irradiated to 25 r on any day from 0.5 to 8.5, regardless of when the other fraction of 25 r was delivered. Day 7.5 may be considered particularly vulnerable. Days 3.5 and 4.5 appeared to be the least vulnerable with any combination, a time just before implantation. It is concluded that the concept of a critical period, cannot be applied to the radiosensitivity of the nervous system since it has been demonstrated that the brain can be affected by exposure to roentgen rays at any time before its development has been completed, even before the initial cleavage of the fertilized egg. It is apparent, from this study, that the mouse embryo is radioresponsive in that congenital anomalies can be produced by roentgen rays from the time of conception at least until organogenesis is completed. Intrauterine deaths may develop following even very low level irradiations. The anomalies following early exposure are probably due to chromosomal aberrations and, following exposure during organogenesis, are probably due to disruptions in the morphogenetic movements of differentiation resulting from the killing of vulnerable cells. While the embryo has remarkable powers of topographic reorganization, it is still to be proved whether it can survive irradiation insult without some permanent damage. It is contended that x irradiation is an insult which results in a deficit embryo, fetus, newborn, and surviving adult when it is applied at any time prior to the completion of organogenesis. Extrapolation of radiation effects from the mouse embryo to the human is not valid. However, such findings suggest that not only should the embryo and fetus be protected against unnecessary x irradiation, but that fractionation of dose may reduce the incidence of some anomalies, but not the over-all damage to the embryo. 66 references. (C.H.)

17716

EFFECT OF TOTAL X-RAY IRRADIATION ON THE CONTENT OF GLYCOGEN IN THE RAT LIVER. R. Ya. Keilina (Central Research Inst. for Medical Radiology, Ministry of Health, USSR, Leningrad). Biochemistry (U.S.S.R.) (English Translation) 24, 889-92(1959) Nov.-Dec.

In control rats starved for 24 hours, the subcutaneous injection of glucose restores the initial glycogen content in the liver. In starved rats totally irradiated with a dose of 1000 r there is an inhibition of assimilation of glucose. Immediately after irradiation, and also after 2, 4, and 96 hours, the glycogen content in the liver in most rats after glucose injection averaged 70% lower than it did in the control animals. (auth)

17717

THE EFFECT OF PLUTONIUM ON THE CONTENT AND RENEWAL OF NUCLEIC ACIDS IN SOME RABBIT TISSUES. V. V. Konstantinova and R. E. Libinzon. Biochemistry (U.S.S.R.) (English Translation) 24, 897-903 (1959) Nov.-Dec.

Results are reported from a study of the effect of Pu on the content of nucleic acids and the intensity of uptake of P^{32} in these compounds in liver, bone marrow, and spleen of rabbits 1, 3, and 6 months after injection of the radioactive substance. When Pu was injected into rabbits in a dose of 7 μcurie/kg, there was a decrease in weight of the liver after 3 and 6 months and a fall in the number of cells in 1 g of bone marrow at all periods of the investigation. The maximum decrease in content of P-RNA in liver and spleen was observed 3 months after the injection. No change in bone marrow P-RNA was observed. The P-DNA content fell markedly in bone marrow and spleen after 3 months, and in liver after 6 months. The amount of DNA and RNA calculated on the weight of the liver fell more sharply than when calculated on the basis of unit weight of organ. The amount of P-DNA in all the organs after 3 and 6 months was 55 and 46%, and the amount of P-RNA was 56 and 36% of the corresponding results for the control animals. The specific activity of RNA increased 1.5 to 2 times in all the tissues in most of the periods of study. The greatest increase in DNA specific activity was in the liver. The activity of bone marrow depolymerases 6 months after injecting plutonium rose. The activity of DNA-asell by 70%, of acid and alkaline RNA-ase increased by 96 and 240%, respectively. (auth)

17718

THE EXISTENCE OF SOME ENZYMATICALLY ACTIVE STATES OF MYOSIN WITH DIFFERENT THERMOSTABILITY. L. Kh. Éidus and G. K. Otarova (Inst. of Biological Physics, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation) 24, 904-13(1959) Nov.-Dec.

By change in the acidity of the solution, the formation of several enzymatically active states of myosin which differ from each other in thermal sensitivity was found. The more thermolabile component is formed from the thermostable one, as can be observed at temperatures of 20 to 30° and decrease in pH to 6.3 to 5.8. This transformation is reversible, but the quantitative ratio of both components depends on pH and on the temperature of the medium. The thermolabile, enzymatically active state of myosin which occurs at definite pH changes and that which occurs in irradiation differ sharply from each other in their properties. Analysis of the literature suggests the general character of the transformation which myosin undergoes in common with a number of other proteins. (auth)

17719

THE UNMASKING BY REGENERATION OF LATENT IRRADIATION EFFECTS IN THE RAT LIVER. K. Weinbren, W. Fitschen, and M. Cohen (London Hospital). Brit. J. Radiol. 33, 419-25(1960) July.

After 5,000 r x irradiation to exteriorized rat liver, only minor microscopical changes are found. If regeneration is stimulated at various times after irradiation, mitoses are inhibited in the early stages, and abnormal mitotic figures appear later. This effect was found as long as one year after irradiation. (auth)

17720

THE EFFECT OF BILE DUCT LIGATION ON LATENT IRRADIATION EFFECTS IN THE RAT LIVER. K. Weinbren and K. V. Ghorpade (London Hospital). Brit. J. Radiol. 33, 426-9(1960) July.

After exposure to 5,000 r x irradiation, bile duct cells appear normal on microscopical examination. Evidence of irradiation damage is found if duct proliferation is stimulated by ligation of the common bile duct. (auth)

17721

RADIATION DOSE IN CINECYSTOURETHROGRAPHY OF THE FEMALE. E. J. Pick, R. Davis, and A. J. Stacey (Univ. of London and Royal Cancer Hospital, London). Brit. J. Radiol. 33, 451-4(1960) July.

The routine cinecystourethrography examination of female patients is described. The methods of estimating the skin and gonad doses received by a representative group of patients are discussed and the results tabulated.

The extent to which various factors contribute to the total dose is analyzed, and a number of ways of avoiding unnecessary exposure are suggested. (auth)

17722

ON ACETYLCHOLINE APPEARING IN BLOOD UNDER THE INFLUENCE OF IONIZING RADIATION. K. V. Smirnov and V. A. Shaternikov. Doklady Akad. Nauk S.S.S.R. 131, 961-3(1960) Apr. 1. (In Russian)

Metabolism of acetylcholine in the small intestine and liver during an exposure to 300 r of Co^{60} γ radiation at 450 to 460 r/min was studied. Before exposure the arterio-peripheral blood and blood from the liver and intestine showed only traces of acetylcholine; 2 hours after exposure acetylcholine appeared in blood from the intestine but was retained in the liver. After 2 days the level of acetylcholine rose in blood from the intestines and increased to 10 to 15 μg-% in the portal vein blood. In two cases the acetylcholine not only passed through the liver but also showed up in arterial blood. Constant uptake of acetylcholine by the liver during radiation injuries produces some favorable effects; however, it may have some negative influence on element exchange in tissues due to irritation of some chemoreceptors. (R.V.J.)

17723

METASTABLE CONDITIONS OF PROTEIN AND NUCLEIC ACIDS DEVELOPING AS A RESULT OF RADIATION. I. I. Sapezhinskiĭ and N. M. Emanuel. Doklady Akad. Nauk S.S.S.R. 131, 1168-70(1960) Apr. 11. (In Russian)

The lifetime for metastable RNA and DNA solutions are 2.5 and 2.4 sec, respectively. The metastable triplet state in albumen and nucleic acids produced by radiation is quite similar to metastable states produced in the same substances in phosphorescent processes, though the excitation mechanism in the latter is quite different. The metastable (biradical) states in albumen and nucleic acids are conducive to the analysis of various reactions of biradicals in complex biological systems. It is postulated that some of the radio-protective action in substances is produced by the metastable states which reduces the opportunity for peroxide biradical formation. (R.V.J.)

17724

CHANGES IN NERVE-CELLS UNDER THE EFFECT OF IONIZING RADIATION. A. D. Smirnov (Kirov Military Medical Academy, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1171-3(1960) Apr. 11. (In Russian)

Morphological changes in neurons of various branches of the nervous system and at various stages of radiation injury were studied in 15 male dogs exposed to whole-body irradiations of 6.3 r/min at 120 cm distance. The dosage in air measured 500 r. The radiosensitivity of nerve cells in spinal ganglia and spinal cord during initial and later stages was analyzed. (R.V.J.)

17725

ACTIVITY OF REDOX ENZYMES AND RESISTANCE OF THE POTATO PLANT TO FUNCTIONAL DISEASES, AS CONNECTED WITH THE EFFECT OF γ-RAYS. E. N. Mukhin (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1177-80(1960) Apr. 11. (In Russian)

Radiation effects on redox enzyme activity and on the tuber pulp resistance to darkening were studied in order to determine the feasibility of utilizing γ radiation (Co^{60}) in potato preservation. The data confirmed the postulation on the importance of redox processes in the development of radiation damage and showed that such processes are not entirely responsible for the darkening of the pulp. (R.V.J.)

17726

STUDIES ON THE DEHYDROGENASE SYSTEM OF BACTERIUM TULARENSE. IV. EFFECT OF X IRRADIATION AND ANIMAL PASSAGE. Satoshi Saito (Fukushima Medical Coll., Japan). Fukushima J. Med. Sci. 6, No. 1, 45-7 (1959) Mar. (In English)

The effect of x radiation and of animal passage on the virulence and succinic dehydrogenase (S.D.H.) activity of B. tularense was studied. Increases in the virulence and S.D.H. activity were observed after the irradiation in the doses of 3,000 and 5,000 r and the subculture for three generations. The virulence and the S.D.H. activity increased in parallel after the passage through mice for ten generations. (auth)

17727

EFFECTS OF X-IRRADIATION UPON THE SUBLINES OF HIROSAKI SARCOMA RESISTANT RESPECTIVELY TO NITROMIN, THIO-TEPA AND MITOMYCIN C. Shoichi Oboshi (Hirosaki Univ., Japan). Gann 50, Suppl., 15-16 (1959). (In English)

The cellular effects of x irradiation on the original line of Hirosaki sarcoma and its three resistant variants were examined. After whole-body x irradiation of 200 or 500 r the mitotic rate of the original line fell in a marked degree, particularly after 1 to 3 hours, and thereafter it showed a tendency to rise again. The fall of the mitotic rate of all resistant variants, which was induced by the x irradiation of the same doses, was identical to that of the original line. From these results, no cross-resistance between the x irradiations and so-called radiomimetic poisons was confirmed. Therefore, the mode of the antineoplastic action of the alkylating agents or mitomycin C might be different from that of the x irradiation, in spite of great similarities of both agents in their biological effect. (auth)

17728

EFFECTS OF X-IRRADIATION ON THE PHOSPHORUS METABOLISM OF EXPERIMENTAL TUMOR OF THE RAT. Hiromichi Matsudaira, Shigeyoshi Masuyama, and Shigeo Horie (Tokyo Univ.). Gann 50, Suppl., 238-9(1959). (In English)

Results are reported from tracer studies using phosphorus-32 to determine the metabolism of phosphorus in experimental tumors in rats. (C.H.)

17729

EFFECTS OF X-RAY IRRADIATION UPON THE EHRLICH CARCINOMA CELLS IN VIVO. ON THE TRANSPLANTABILITY AFTER X-RAY IRRADIATION UPON THE TUMOUR BED. Tsutomu Yoshinari and Tadaharu Nosaki (Osaka Univ.). Gann. 50, Suppl., 239-40(1959).

The effects of x irradiation on the growth of transplanted Ehrlich carcinoma cells in male mice were studied. Differences were found in response when the irradiation of the cells was administered in vitro and in vivo. (C.H.)

17730

EFFECTS OF RADIATION ON HeLa CELLS. REPORT 1. EFFECTS OF X-IRRADIATION. Iwao Kanno, Eiju Umehara, Kazue Fukushi, Junji Yamaguchi, Keiji Utagawa, Kazuo Sato, Yasuhiko Iko, and Kazuo Ogata (Tohoku Univ.). Gann 50, Suppl., 240-1(1959). (In English)

The effects of single doses of x radiation ranging from 100 to 1,000 r on HeLa cells in tissue culture were studied. Results are summarized. (C.H.)

17731

GIANT CELL FORMATION OF HeLa CELLS UNDER THE EFFECT OF IRRADIATION AND ANTITUMOR DRUGS.

Yukio Nodake, Shozo Tamura, and Ichiro Wakamatsu (Keio Univ., Tokyo). Gann 50, Suppl., 241-2(1959). (In English)

Cytopathological changes such as size increase, vacuolization, multiple nuclei, and nuclear changes were observed in HeLa cells in tissue culture following exposure to irradiation. The effects of several antitumor drugs were also evaluated. (C.H.)

17732

EXPERIMENTAL STUDIES ON AQUIRED RADIORESISTANCE OF TUMOR CELLS. Shoichi Oboshi and Tatsuyo Shinozaki (Hirosaki Univ., Japan). Gann 50, Suppl., 242-3(1959).

Tumor cells which were consecutively treated with relatively small doses of x radiation for a 150 day period showed no signs of the development of radioresistance. (C.H.)

17733

EFFECT OF X-RADIATION ON THE ASCITES TUMORS: DIFFERENCE IN RADIOSENSITIVITY AMONG VARIOUS TRANSPLANT-STRAINS OF THE ASCITES HEPATOMA OF THE RAT. Yahiro Irako Medical Inst. of Sasaki Foundation, Tokyo). Gann 51, 33-45(1960) Mar.

Factors affecting the radiosensitivity of twenty transplant-strains of the ascites hepatoma of the rat were studied. Tumors derived from the same ancestry varied in radiosensitivity. The radiosensitivity was related to their growth velocity, the slower growing tumors being more radiosensitive than the faster growing tumors. No correlation was found between the radiosensitivity of tumors and the sensitivity of the tumors to HN_2 derivatives. (C.H.)

17734

PLEIOTROPIC EFFECTS OF A MUTANT AT THE P LOCUS FROM X-IRRADIATED MICE. W. F. Hollander, J. H. D. Bryan, and John W. Gowen (Iowa State Univ. of Science and Tech., Ames). Genetics 45, 413-18(1960) Apr.

A presumably x-ray-induced mouse mutation at the p locus, recessive to both p and wild type alleles, has been analyzed. When homozygous the mutant produces the same effect on pigmentation as p p, but in addition there is poor growth, slightly uncoördinated behavior, difficulty in chewing, inadequate maternal care by females, sterility in males, premature senility, and abnormal wearing of the incisor teeth. The male sterility is not quite absolute, and is partly the result of poor mating response and partly a very high proportion of sperms with abnormal head structure. Since chromosome aberration seems not to be involved in the origin of this mutant, it is considered a new allele with unusual pleiotropic effects, and is symbolized p^8. (auth)

17735

RADIOBIOLOGICAL STUDIES IN PLANTS. I. EFFECT OF X-RAYS UPON POLLEN GERMINATION AND FERTILITY. Ichizo Nishiyama and Setsuko Tsukuda (Kyoto Univ.). Idengaku Zasshi 34, 363-70(1959) Nov. (In English)

Pollen grains from four species of plants were exposed to various doses of x radiation. Fruits which developed following pollination with the irradiated pollen were very small and contained few or no mature seed. Data are presented graphically and results are discussed. (C.H.)

17736

ELECTROPHORESIS OF THE SOLUBLE PROTEINS OF THE LYMPHATIC TISSUE OF NORMAL AND IRRADIATED RATS. R. Caravaglios (Università, Pisa, Italy). Ital. J. Biochem. 6, 342-52(1957) Nov.-Dec. (In English)

The soluble protein composition of the lymphatic tissue of normal and irradiated rats has been studied by paper electrophoresis. The electrophoretic pattern of the soluble proteins at pH 6.8, extracted from normal animals, showed 6 protein components to be present. One component was insoluble at pH 5 and was separated by acidifying the protein solution. At various intervals after total irradiation of the body with x rays (500 r), the soluble protein pattern showed no qualitative or quantitative alterations although considerable histological changes were observed. The significance of the results is discussed. (auth)

17737

INFLUENCE OF X-IRRADIATION ON THE SOLUBLE PROTEINS OF LIVER. L. Cima, G. Fassina, and F. Pozza (Università, Padua). Ital. J. Biochim. 8, 212-19(1959) July-Aug.

The effect of x irradiation on the soluble proteins of liver cells from irradiated rats was studied. Electrophoresis showed that the faster-moving fractions (pre-albumin, albumin, and α-globulins) were increased. The in vitro irradiation of protein extracts obtained from nonirradiated animals produced an increase in absorption at 2400 and 2780 A without altering the electrophoretic pattern. (auth)

17738

STUDY OF A CASE OF CHRONIC PROFESSIONAL IRRADIATION. PROVISIONAL DETERMINATION OF THE EFFECTS OF THIS IRRADIATION. P. Minet. J. belge radiol. 43, 62-70(1960). (In French)

The case of a chemist submitted to professional chronic irradiation, in the absence of a physical check doses received, was studied to estimate the deleterious effects of this irradiation on the patient and his descent. No connection was found between the observed symptoms and this irradiation. The health of the patient did not seem to be affected in any important way. The only objective symptom, a depression of the spermatogenesis, was followed by spectacular recuperation. In the absence of objective symptoms, it is felt that there is no reason to fear genetic consequences neither for the patient nor for his offspring. (auth)

17739

"OXYGEN EFFECT" AND TUMOR SIZE AS RELATED TO RESPONSE OF C3H/Ba ADENOCARCINOMA TO LOCAL X IRRADIATION. Herman Suit, Lawrence Schlachter, and J. Robert Andrews (National Cancer Inst., Bethesda, Md.). J. Natl. Cancer Inst. 24, 1271-81(1960) June.

The C3H/Ba mammary adenocarcinoma transplanted into the thigh muscle of the C3H/He mouse, the inbred strain of mice in which the tumor originated, was studied by irradiation in vivo with an opposed pair of 250 kv x-ray beams. Tumors 7 to 10 mm in diameter were lethally damaged by 5500 r in greater numbers than tumors 10 to 15 mm in diameter. When the treatment was given while the animals breathed 100 per cent O_2 under 2 atmospheres of pressure instead of air at 1 atmosphere of pressure, results with the small tumors indicated that the increased oxygen tension slightly enhanced the cure rate; tumors 10 to 15 mm in diameter did not show a greater cure rate if the therapy were given under increased oxygen tension. The data show that there is a rapid and progressive anemia (decrease in hematocrit) with growth of the tumor. (auth)

17740

DIAGNOSIS OF RADIATION EFFECTS AT LOWER DOSE RATES IN THE HUMAN ORGANISM. M. P. Domshlak (Domšlak), L. L. Vannikov, and Yu. G. (J.) Grigor'ev. Kernenergie 1, 357-60(1958) May. (In German)

The increasing application of nuclear energy in different business fields and military tests has led to this study of radiation doses to the population. The development of methods for diagnosis of latent changes in health condi-

tions of irradiated persons is of decided importance. A survey of the research methods which were developed mainly in the USSR and of the diagnosis methods of radiation effects in human beings for low doses is given. (tr-auth)

17741

OBSERVATION ON THE EFFECT OF PROTECTION OF THE INTESTINE ON THE LETHALITY PRODUCED BY TOTAL BODY γ-IRRADIATION IN RATS. H. Takayama, K. Nishioka, and T. Sunada (Osaka Univ.). Med. J. Osaka Univ. 10, 535-41(1960) Mar. (In English)

Rats whose intestines were protected from gamma radiation lived more than two months following exposure to a single dose of 1,500 r, while rats which received 1,000 r whole-body radiation died within seven days. Rats whose exteriorized intestines were irradiated survived 800 and 1,000 r, but 60% died after exposure to 1,200 r, and all died within seven days after irradiation with a dose of 1,500 r. Rats whose abdomens were irradiated showed a high mortality. (C.H.)

17742

THE SIGMOID SURVIVAL CURVE IN RADIOBIOLOGY. Tikvah Alper and N. E. Gillies (Hammersmith Hospital, London) and M. M. Elkind (National Cancer Inst., Bethesda, Md.). Nature 186, 1062-3(1960) June 25.

Interpretations of the sigmoid survival curve in radiobiology are discussed from the standpoint of the existence of a multiplicity of target or hit number of discrete morphological sites or entities when considering single-cell populations. (C.H.)

17743

INABILITY OF METHIONINE TO AFFECT LETHALITY IN MICE AND RATS EXPOSED TO X-RAYS. Zenon M. Bacq and Marie L. Beaumariage (Institut Interuniversitaire des Sciences Nucléaires, [Liège]). Nature 186, 1064(1960) June 25.

The administration of methionine afforded no decrease in the mortality of mice and rats exposed to doses of 700 or 800 r of x radiation. Data are tabulated. (C.H.)

17744

AGEING AND RADIATION. G. J. Neary (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Nature 187, 10-18(1960) July 2.

A model of aging is presented which is based on evidence on irradiated and unirradiated mice. It assumes that there is a common process at work in natural and radiation-induced aging which is fundamental, inevitable, and irreversible. Data are reviewed from a number of studies on aging and the role of irradiation on aging. 59 references. (C.H.)

17745

ROLE OF INITIAL VALUE OF METABOLIC PROCESSES IN OXYGEN CONSUMPTION CHANGES IN RATS DURING IRRADIATION. A. Vacek (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Nature 187, 76-7 (1960) July 2.

Changes in respiratory metabolism arising in rats during x irradiation have shown that x rays influence the course of metabolic processes during the period of exposure. Results are presented from measurements of oxygen consumption in 100 male rats which indicate that it is more important to know the initial oxygen consumption value of every experimental animal than the average value of the whole experimental group of animals. (C.H.)

17746

THE RELATIVE GENETIC EFFECTIVENESS OF HARD AND SOFT X RADIATION AND 25-Mev ELECTRONS IN THE REMUTATION TEST IN NEUROSPORA. H. Marquardt and F. Zimmermann (Universität, Frieburg i. B.). Naturwissenschaften 47, 235(1960). (In German)

Conidii from 10-day-old cultures of strain K 3/17 of Kølmark Neurospora crassa were exposed to 25-Mev electrons (900 rad/min), 65-kv x radiation (54,000 r/min), and 185-kv x radiation (1400 r/min). The samples were washed and diluted, and four days later the number of adenin-autotrophic remutations were determined. The results are given in number of remutations per 10^6 surviving conidii. The number of adenin-autotrophic remutations increases with the dose with the 185-kv x radiation, but it does not with the 65-kv radiation. The electrons at 10 kr give a statistically lower remutation rate than the x radiations, but over 25 kr this difference disappears. (J.S.R.)

17747

IONIZING RADIATIONS AND HUMAN ORGANISM. B. N. Tarusov. Priroda 49, No. 3, 33-8(1960) Mar. (In Russian)

Chemical preparations as prophylactics against ionizing radiation injuries in humans are reviewed. (R.V.J.)

17748

OXYGEN AND NITRIC OXIDE AS MODIFIERS OF RADIATION INJURY IN SPORES OF BACILLUS MEGATERIUM. E. L. Powers, R. B. Webb, and B. F. Kaleta (Argonne National Lab., Ill.). Proc. Natl. Acad. Sci. U. S. 46, 984-92 (1960) July.

The radiation sensitivity of dry spores of Bacillus megaterium is influenced by the presence of the gases oxygen and nitric oxide both during and after irradiation. When irradiated in the presence of oxygen, the spores demonstrate maximal sensitivity. A reduction of about 30 per cent in sensitivity is observed when irradiation in nitrogen is followed immediately by exposure to oxygen. The radiation sensitivity observed in nitrogen can be reduced one-half by post-irradiation exposure to nitric oxide prior to exposure to oxygen. These results are interpreted to indicate the formation by radiation of long-lived free radicals which in combination with oxygen form irreversible lethal substances. The action of nitric oxide is the harmless removal of these radicals. However, when irradiation is performed in the presence of NO, the radiation sensitivity is approximately 20 per cent higher than that seen when NO is given after irradiation. This, having about the same magnitude as the immediate oxygen effect, is equated to it, and this damage is brought about by an action of the two gases that is similar. Such an action is the quenching of luminescence that conserves energy within the spore with a corresponding increase in damage. This action of O_2 and NO is to be distinguished from the postirradiation action of oxygen which is interpreted to be the result of the activation of oxygen in the cell by the products of radiation. (auth)

17749

EFFECT OF DAILY EXPOSURE TO 15 r γ RADIATION ON SUSCEPTIBILITY OF MICE TO EXPERIMENTAL INFECTION. Carolyn W. Hammond, Sonia K. Anderle, and C. Phillip Miller (Univ. of Chicago). Proc. Soc. Exptl. Biol. Med. 104, 261-3(1960) June.

CF-1 female mice were exposed to approximately 15 r a day radiation for 9 to 15 weeks and challenged at intervals by intraperitoneal inoculation with graded doses of Pseudomonas aeruginosa. Comparison of LD_{50} of irradiated and control mice in each challenge showed that between 9th and 15th weeks a slight but demonstrable increase in susceptibility to experimental infection had occurred. The increase caused by accumulation of 1350 r during 15 weeks exposure

was, however, very much less than that resulting from a single acute exposure to 300 r x radiation. (auth)

17750

ANTIOXIDANTS AND SURVIVAL TIME OF MICE EXPOSED TO MULTIPLE SUBLETHAL DOSES OF X-IRRADIATION. Benjamin H. Ershoff and C. W. Steers, Jr. (Western Biological Labs., Culver, City, Calif.). Proc. Soc. Exptl. Biol. Med. 104, 274-6(1960) June.

Experiments were conducted to determine effects of antioxidants on survival time of mice exposed to multiple sublethal doses of total-body x irradiation. Mixed tocopherols and Santoquin at 0.25% level in the diet, and DPPD at levels of 0.25% or 0.5% of diet had little if any protective effect. Propyl gallate, DBH, and BHT at levels of 0.25% or 0.5% of the diet increased survival over that on basal unsupplemented ration. (auth)

17751

RESPONSE OF MOUSE BREAST TUMORS TO L-TRIIODOTHYRONINE AND IRRADIATION. John R. Spengler, Andrew B. Crummy, Jr., and Halvor Vermund (Univ. of Wisconsin, Madison). Proc. Soc. Exptl. Biol. Med. 104, 286-8(1960) June.

Growth rate of transplanted mammary tumor in mice treated with L-triiodothyronine was increased. Average life span of tumor-bearing mice receiving L-triiodothyronine was significantly shortened. In mice receiving L-triiodothyronine and x ray, increased skin reaction was noted. There was no significant difference between average life span of tumor-bearing groups receiving combined irradiation plus triiodothyronine and the group which received local irradiation only. (auth)

17752

THE EFFECT OF WHOLE-BODY X-IRRADIATION ON THE LANGERHANS' ISLETS IN THE RAT. Nikša Allegretti, Miloje Matošić, Neda Šestan, Magda Devčić, Luka Rabadjija, and Suzana Šlamberger (Inst. "Rudjer Boškovic," Zagreb). Radiation Research 13, 18-24(1960) July.

The sublethal total-body x irradiation of the rat causes an increase in the β/α-cell ratio of the insular tissue 24 hours after irradiation. The ratio decreases gradually until nearly the thirtieth day, and after that period it rises again. The first increase could be ascribed to the formation of new islets containing mostly β-cells; the last increase, however, could be ascribed to the growth of the islets by formation of β-cells. (auth)

17753

EFFECTS OF SUBLETHAL WHOLE-BODY X-IRRADIATION ON GLUCOSE TOLERANCE IN THE RAT AND THE GUINEA PIG. Neda Šestan, Nikša Allegretti, Miloje Matošić, and Magda Devčić (Inst. "Rudjer Boškovic," Zagreb). Radiation Research 13, 25-30(1960) July.

The glucose tolerance test (GTT) was performed in rats and in guinea pigs at several time intervals after x irradiation. In the rat an impairment of glucose utilization was observed on the eighth postirradiation day, followed by an improvement becoming more and more pronounced toward the end of the third postirradiation month. In the guinea pig the impairment of glucose utilization is much more marked with a maximum on the tenth postirradiation day. (auth)

17754

THE EFFECT OF WHOLE-BODY X-IRRADIATION ON THE LANGERHANS' ISLETS IN THE GUINEA PIG. Nikša Allegretti, Miloje Matošić, Neda Šestan, and Suzana Šlamberger (Inst. "Rudjer Boškovic," Zagreb). Radiation Research 13, 31-6(1960) July.

Sublethal total-body x irradiation of the guinea pig produces a fall in the β/α-cell ratio curve of the Langerhans' islets on the second and third postirradiation days followed by an increase on the fifth day and an irregular course until day 120. By distributing the islets according to the size, it was possible to conclude that small islets showed a marked increase in the ratio immediately after x irradiation, the large ones showed an increase toward day 120, and the 5-day peak was due to the increase of the ratio in the islets of all sizes. Distribution curves made it possible to conclude that transformation of islet cells can occur. (auth)

17755

RADIATION INACTIVATION OF DEOXYRIBONUCLEASE IN THE DRY AND HYDRATED STATES. S. Okada and G. L. Fletcher (Univ. of Rochester, N. Y.). Radiation Research 13, 92-8(1960) July.

Dried desoxyribonuclease I adsorbed on cellulose, Celite, and Dowex 50 was more radiosensitive than the pure enzyme in the absence of adsorbents. The enzyme dried with DNA was protected from radiation-induced inactivation of the enzyme. Wet desoxyribonuclease, containing about 50% water, was less radiosensitive than dry enzyme. This suggests that bound water protects against radiation inactivation. The adsorbed enzyme was more radiosensitive when irradiated in air. The mechanisms responsible for these observed phenomena could be explained by inter- or intramolecular energy transfer. (auth)

17756

POSTIRRADIATION PROTECTION OF X-IRRADIATED MICE WITH OLIVE OIL. James K. Ashikawa and Orland K. Anderson (Univ. of California, Berkeley). Radiation Research 13, 99-107(1960) July.

Olive oil administered intraperitoneally is both protective and therapeutic to whole-body x-irradiated male Swiss white mice. This beneficial effect is manifested during the bone marrow phase by an increase in survival, a change in the mortality distribution, and a decrease in weight loss. The effect was most pronounced in the MLD group, where almost 90% of the postirradiation oil-treated animals survived. The intraperitoneal administration of lycopene had a questionable effect on irradiated mice. A carefully controlled comparative experiment on irradiation methodology demonstrates the tremendous importance of rigorously controlling physical and biological parameters in radiation protection studies. (auth)

17757

CYTOPHOTOMETRIC DETERMINATIONS OF NUCLEIC ACID IN RAT LYMPHOCYTES AFTER IRRADIATION. G. Hjort (Cambridge Univ., Eng.). Radiation Research 13, 108-14(1960) July.

Rat lymphocytes irradiated with 300 to 1200 r of x rays and measured by ultraviolet microspectrophotometry show no changes in average nucleic acid concentration in morphologically normal cells within 6 hours after irradiation. However, a greater variance of the cytoplasmic nucleic acid concentration was found among irradiated cells. The corresponding difference found for nuclei was of doubtful significance. (auth)

17758

THE RADIATION SENSITIVITY OF NORMAL MOUSE BONE MARROW CELLS, DETERMINED BY QUANTITATIVE MARROW TRANSPLANTATION INTO IRRADIATED MICE. E. A. McCulloch and J. E. Till (Univ. of Toronto and Ontario Cancer Inst., Toronto). Radiation Research 13, 115-25(1960) July.

A technique for measuring the number of viable cells in

a suspension of bone marrow by quantitative transplantation into supralethally irradiated mice was described. The technique was used to measure the radiation sensitivity of normal mouse bone marrow cells and yielded a result of 105 ± 24 rads as the D_{37} for marrow cells. (auth)

17759

AUTORADIOGRAPHIC STUDY WITH TRITIATED THYMIDINE OF MOUSE TESTIS AFTER 320 r AND AFTER 1000 r OF ACUTE LOCALIZED X-IRRADIATION. Bernard R. Nebel, Carol J. Murphy, and Harris J. Linder (Argonne National Lab., Ill.). Radiation Research 13, 126-36(1960) July.

Two groups of C57 black male mice approximately 100 days old were subjected to 320-r and 1000-r doses of acute localized x irradiation, respectively. The 320-r series was injected with tritiated thymidine 10 to 15 minutes before exposure; the 1000-r series, 24 hours previously. The distribution of stages showing labeled cells was compared in 320-r and control material and found to be synchronous in both series. After 320 r the respective range of stages at each sacrifice date is narrower than in the control, owing to selective killing of type B spermatogonia. Thus a narrower stream of labeled cells is fed into early meiosis. With 1000 r, synchrony also exists as long as cells are present to maintain it. Cell death is not limited to spermatogonia. After 320 r there is also some loss of spermatocytes and a severe loss of spermatids over and beyond the loss resulting from diminished recruitment. The thymidine label made it possible to trace labeled restitution cells from their original position in the tubule to the basement membrane, but the present study allows no statement concerning their life span and ultimate fate. (auth)

17760

DESTRUCTION OF THE ACTIVITY OF DEOXYRIBONUCLEIC ACID IN IRRADIATED CELLS. Franklin Hutchinson and Josephine Arena (Yale Univ., New Haven). Radiation Research 13, 137-47(1960) July.

The radiosensitivity of deoxyribonucleic acid within irradiated pneumococcus cells has been studied by extracting the deoxyribonucleic acid after irradiation and measuring its ability to transform a related strain of pneumococcus to streptomycin resistance. The inactivation curves found are exponential over several orders of magnitude, and the measured D_{37}'s are: irradiation in the dry state, 3.0 MR; irradiation in the wet anoxic state, 1.2 MR; wet, with oxygen, 0.4 MR; wet with oxygen and 1% cysteamine, 1.2 MR. The data in the dry state are consistent with a unit of transforming activity with a molecular weight of 240,000. The increase in radiosensitivity from the dry state to the wet state can be understood on the assumption of radiation-produced radicals from water diffusing a distance of the order of 10 A. The deoxyribonucleic acid radiosensitivity varies with oxygen and with cysteamine concentrations in the same way as the ability of irradiated cells to reproduce, and the significance of this similarity is discussed. (auth)

17761

CX-REACTIVE PROTEIN RESPONSES IN THE RABBIT AFTER WHOLE-BODY IRRADIATION. Richard F. Riley, Monroe K. Coleman, and Y. Hokama (Univ. of California, Los Angeles). Radiation Research 13, 148-55(1960) July.

Cx-protein was present in the serum of all rabbits exposed to whole-body doses of 250 to 750 r of x rays 24 hours after exposure, and the maximum Cx-protein titer was usually observed at this time. Not all animals gave a Cx-protein titer 24 hours after 100 r or less. The mean 24-hour titer was about the same after doses of 100 to 750 r. The response was commonly biphasic in fed rabbits and monophasic in rabbits denied food during the postirradiation period. Treatment with compound 48/80 produced a Cx-protein response and animals so treated behaved like controls when subsequently given 250 r. Pyrilamine did not modify the Cx-protein response to 250 r of x rays. (auth)

17762

THE SUPPRESSION BY CORTISONE OF THE ACUTE LOCAL RADIATION REACTION IN THE RABBIT EAR. W. R. Bruce and W. R. Barclay (Univ. of Chicago). Radiation Research 13, 168-84(1960) July.

The action of cortisone on the response of the skin of the rabbit ear to a single x-ray exposure was investigated. Gross and microscopic studies were done after tissue doses of 1000 to 30,000 r. Doses of 1 to 20 mg of cortisone per day parenterally (and 2.5% local cortisone) were started and then discontinued over a period of 2 days prior to irradiation to 90 days postirradiation. These studies confirm the finding that cortisone will suppress ulceration over a range of radiation dosage and demonstrate a remarkable suppression of inflammation after the initial degenerative changes, as long as the cortisone is continued. The results indicate that inflammation is secondary to degeneration of cells and is suppressed locally. (auth)

17763

CHEMICAL PROTECTION OF VERTEBRATES AGAINST IONIZING RADIATIONS. Z. M. Bacq (Université, Liège). Radiobiol. Latina 2, 191-206 (1959) July-Sept. (In Italian)

There are many substances of very varied chemical structure which protect mammals and other living organisms against x or γ irradiation. That some change occurs in physicochemical events, early after energy absorption, is the only logical explanation of the protection afforded by the presence of cysteamine or related compounds. Certain physicochemical mechanisms may apply to anoxic and aerated systems, some are restricted to aerated systems. Some substances, like cysteamine, protect against both indirect action involving free radicals and direct action by energy transfer. There is no reason to reject the hypothesis that several physicochemical mechanisms of protection may be simultaneous and synergistic. A revised interpretation is proposed for mammalian protection by the cysteamine type of protector. Some protectors, like histamine, adrenaline, and p-aminopropiophenone, probably act in the mammals mainly by reducing the O_2 tension in the tissues. Fluoroacetate and some other substances seem to protect by the induction of slow biochemical changes. (auth)

17764

THE LEVELS OF URINARY 17-KETOSTEROIDS IN IRRADIATED CANCER. R. Bossi, U. Nuvolone, G. Pisani, and R. Sorrentino (Centro Studi di Radiobiologia e Cancerologia Sperimentale Ospedale Maggiore, Novara, Italy). Radiobiol. Latina 2, 207-22 (1959) July-Sept. (In Italian)

Results are reported of a study of the urinary 17-ketosteroids in about a hundred cancer patients before, during, and after radiation therapy with either x rays or cobalt. The changes found were of little significance and independent of the localization of the tumor or the type of radiation. It is concluded that study of 17-ketosteroid excretion alone cannot give any useful information about the effect of radiation therapy on adrenocortical function. (auth)

17765

CHANGES IN IMMUNE REACTIONS OF ANIMALS IRRADIATED DURING HIBERNATION. G. Gasso, M. Girlando, and A. Billitteri (Università, Catania, Italy). Radiobiol. Latina 2, 233-6(1959) July-Sept. (In Italian)

In animals irradiated during artificial hibernation, the opsonic power of the blood showed no statistically significant alteration during the whole course of the experiment, whereas it appeared to diminish significantly in animals irradiated at body temperature. This result is in agreement with the results of previous studies which showed no diminution in gamma globulin or in complement activity in animals irradiated during hibernation. (auth)

17766

BEHAVIOR OF THE EOSINOPHILES AND THE THORN TEST IN IRRADIATED CANCER PATIENTS. R. Bossi, U. Nuvolone, G. Pisani, and R. Sorrentino (Centro Studi di Radiobiologia e Cancerologia, Istituto Radiologico dell'Ospedale Maggiore, Novara, Italy). Radiobiol. Latina 2, 237-53(1959) July-Sept. (In Italian)

The behavior of the blood eosinophils, the Thorn test, and radiation sickness in patients with malignant tumors treated with x-ray or cobalt therapy were studied. During the initial phases of irradiation the eosinophils are affected by the adrenal glucocorticoid hormones and consequently diminish in number; during the later phases they tend to increase. In general the Thorn test shows no alterations which could be related to the changes in blood eosinophils and this is evidence in support of the view that the eosinophilia is independent of neuro-endocrinological control. The course of radiation sickness symptoms seems to be unrelated to the number of eosinophils, but it is related to the values of the Thorn test. (auth)

17767

THE BEHAVIOR OF KETOSTEROIDS, GLUCOCORTICOIDS, AND MINERALOCORTICOIDS AFTER TREATMENT OF MALIGNANT TUMORS WITH RADIATION. R. Bossi, U. Nuvolone, G. Pisani, and R. Sorrentino (Centro Studi di Radiologia e Cancerologia, Istituto Radiologico dell'Ospedale Maggiore, Novara, Italy). Radiobiol. Latina 2, 255-79(1959) July-Sept. (In Italian)

The results are described of a study of the changes in urinary 17 ketosteroids (17 Ks), glucocorticoids, (11 OC) and mineralocorticoids (11 DOC) in 20 patients with malignant tumors treated with x-ray or telecobalt therapy. It was observed that during irradiation treatment the curve for the 17 Ks was opposite to that for the 11 OC and 11 DOC, with the culminating points sometimes exactly opposed. Whereas the curve for the 11 OC and 11 DOC tended to increase gradually with the maximum point near the end of the treatment, the curve for the 17 Ks, after a transitory rise during the first few days of treatment, tended to fall. Frequently a parallelism could be observed between the course of the symptoms and that of the urinary excretion of 11 OC and 11 DOC. This indicates that the increased excretion of 11 OC and 11 DOC is the expression of a defense reaction against the somatic lesions produced by irradiation. In most cases therefore the radiation sickness was not accompanied by changes suggestive of exhaustion of adrenocortical function. (auth)

17768

THE RADIOPROTECTIVE EFFECT OF A CYSTEAMINE–CYSTAMINE–GLUTATHIONE SYSTEM. ANATOMICAL-FUNCTIONAL INVESTIGATION ON THE BONE MARROW AND PERIPHERAL BLOOD. E. G. Rondanelli, P. Gorini, A. Trenta, and G. P. Fiori (Università, Pavia, Italy). Radiobiol., radioterap. e fis. med. (3) 15, 3-30(1960). (In Italian)

In a study of the radioprotective effects of a system of cystamine, cysteamine, glutathione, vitamin B_6, vitamin C, and glucuronolactone on the biological activity of the bone marrow and the peripheral blood, thirty patients (ten with pulmonary carcinoma, ten with uterine carcinomas, and ten with larynx carcinomas) treated with x radiation were investigated. Systematic hematological studies were made on all the patients before the irradiation, at the end of the therapy, and thirty days later. In patients receiving the radioprotective preparation the state of myelocitopenia following x-ray therapy was less marked than in the controls even immediately after the end of the irradiation. The proliferative activity of the erythroblasts and granuloblasts was less concentrated in patients with radioprotection. The study of the maturative activity of the erythroblast and granuloblast series shows that the alteration of this activity as a result of the radiation is less in patients receiving the cysteamine system. The results obtained in the myelological investigation shows a rigid parallelism with peripheral hemochromocytometric evidence. This indicates that the preparation has a protective effect on the basic biological activity of the myeloid cells, increases the functional renewal, and gives protection at the blood platelet level of the peripheral blood. (tr-auth)

17769

COMPARISON OF THE EFFECTS OF ISOLOGOUS, HOMOLOGOUS, AND HETEROLOGOUS HEMATOPOIETIC TISSUES ON POST-IRRADIATION SURVIVAL. Leon O. Jacobson and Eric L. Simmons (Argonne Cancer Research Hospital, Chicago). Radiology 75, 6-10(1960) July.

Studies on the treatment of radiation injuries are reviewed. The effects of isologous, homologous, and heterologous hematopoietic tissue on long-term survival against irradiation death are discussed. The role of the immune response and mechanisms involved in host-graft response are discussed. The use of embryonic tissues and the possibility of the development of suppressor substances to alter the immune behavior pattern are discussed. (C.H.)

17770

THE THEORY AND PRACTICE OF TOTAL-BODY IRRADIATION IN THE DAWN OF THE HOMOGRAFT ERA. James B. Dealy, Jr. (Harvard Univ. Medical School, Boston). Radiology 75, 11-18(1960) July.

The administration of total-body radiation as a prelude to the transplantation of tissues between genetically unrelated individuals is discussed. Results are reviewed from animal experiments. Experiences with humans are summarized. Results are described for a group of patients given total-body irradiation before kidney transplantation. The hematologic responses of the patients are discussed. Fields where research is most needed are outlined. (C.H.)

17771

GENERAL THEORY OF MORTALITY AND AGING. A STOCHASTIC MODEL RELATES OBSERVATIONS ON AGING, PHYSIOLOGIC DECLINE, MORTALITY, AND RADIATION. Bernard L. Strehler and Albert S. Mildvan (National Institutes of Health, Bethesda, Md. and Baltimore City Hospitals). Science 132, 14-21(1960) July 1.

A theory of the kinetics of death is presented which is based upon the experimentally determined Gompertz function and the postulates that the distribution of stress magnitudes is a Maxwell-Boltzmann distribution and an organism dies when stress magnitude exceeds the organism's maximum ability to compensate therefor. The theory predicts a zero-order loss of function versus age. This is borne out in human males by independent observation. The theory permits several independent calculations of the value of B, the percent of loss per year of physiologic function. The calculated values range from 0.9 to 1.4 percent per year and agree closely with the observed rates in human males. The theory predicts an inverse linear relationship between Gompertz slope and ln R_0 (intercept), which is closely confirmed by observation. The theory predicts that the mean ratio of maximum reserve capacity to average demand lies between 7 and 11. Independent physiologic measurement data are in reasonable agreement with these values. The theory predicts the observed effects of prolonged or instantaneous exposure of experimental animals to ionizing radiation. The relative deleteriousness (D) of various national environments can be calculated. They have been found to differ by approximately 50 percent. We have been unable to make an independent test of these relative values. Despite the fact that it is derived for a homogeneous population the theory is shown to be not inconsistent with individual variability within a population. (auth)

17772

EXPERIMENTAL CONTRIBUTION TO THE TREATMENT OF LOCAL INFLAMMATORY AND GENERAL X RAY REACTIONS WITH ACTH AND CORTISONE DERIVATIVES. Arthur Wiskemann (Universitäts-Hautklinik, Hamburg-Eppendorf). Strahlentherapie 112, 188-212(1960). (In German)

Injected ACTH suppresses erythema and ulcer formation on x-irradiated skin of guinea pigs as long as it is applied in sufficient doses. It is effective also when applied following the onset of the irradiation. It increases the growth inhibition of radiation on the Yoshida sarcoma of the rat. The average survival time of guinea pigs following a lethal dose of abdominal irradiation is increased significantly by ACTH given for the first time following the irradiation, and Prednisolon, given for the first time 24 hours prior to the irradiation. Both hormones increase the mortality rate following total-body irradiation with sublethal and lethal doses. Based on results of animal experiments, a partial suppression of the unspecific inflamatory and general radiation reactions in humans can be expected from ACTH medication for several weeks immediately following the treatment. Local treatment of the radiation reaction with 1% hydrocortisone ointment decreases the x-ray erythema only if it is applicated some time prior to the irradiation. For the treatment of radiation sickness due to reactor disasters and nuclear weapons ACTH and cortisone derivates are contraindicated. (auth)

17773

RELATIVE BIOLOGICAL EFFECTIVENESS OF 15-MEV ELECTRON AND 200-KV X RADIATION ON BARLEY SEEDLINGS. Benno Markus (Universitäts-Hautklinik, Göttingen, Ger.). Strahlentherapie 112, 213-28(1960). (In German)

Some important physical suppositions for the accurate examination of the relative biological effectiveness of fast electrons and possible errors in dosimetry are pointed out. The errors might change the quantitative results and also may show false qualitative effects of fast electrons. The possible errors were eliminated and special growing methods were used. For electron- and x-irradiated barley seeds (Hordeum vulgare) the doses of 50% growth inhibition (D_{50}) and 10% growth inhibition of roots, koleoptiles, and leaves were determined. This gave a uniform RBW of 0.79 ± 0.04. On a number of further biologic criteria striking qualitative and quantitative conformity of the effect of x rays and fast electrons was observed. The qualitative differences of the effect of fast electrons, and RBW-values, reported by other authors could not be confirmed. Possibilities of a partial explanation of these discrepancies are pointed out. (auth)

17774

THE IMPORTANCE OF ELECTROENCEPHALOGRAPHY IN X-RAY EPILATION OF CHILDREN'S HEADS. Milan Schwarzwald and Gjorgje Vukadinovic (Faculty of Medicine, Zagreb and Inst. for Medical Research, Yugoslav Academy of Sciences and Arts, Zagreb). Strahlentherapie 112, 242-50(1960). (In German)

Results from studies on thirty-two children of both sexes, from 4 to 10 years of age, indicate that x-ray-induced epilation does not cause pathological changes in the electroencephalographic picture. (C.H.)

17775

FURTHER RESEARCH ON THE BIOLOGICAL EFFECTS OF RADON AND ITS DECAY PRODUCTS. Karl Aurand, Wolfgang Jacobi, Hermann Muth, and Alfred Schraub (Max-Planck-Institut für Biophysik, Frankfurt am Main and Forschungsinstitut Gastein, Österreichische Akademie der Wissenschaften, Badgastein, Austria). Strahlentherapie 112, 262-72(1960). (In German)

Results are reported from a survey of the natural radioactivity due to radon and its decay products in samples of air and ground waters collected in a deep valley region with high emanation of radioactivity from spring waters. The radiation burden of humans living in the area was measured. Estimations are included of the radiation exposure of the lungs from radon and thoron decay products and the retention of radioactive aerosols in the human respiratory tract. (C.H.)

17776

CONTRIBUTION TO THE TOLERANCE-DOSE PROBLEM FOR RADIUM-EMANATION IN ANIMAL EXPERIMENTATION. Otto Henn (Forschungsinstitut Gastein, Österreichische Akademie der Wissenschaften, Badgastein, Austria). Strahlentherapie 112, 293-308(1960). (In German)

In a great number of experiments the effect of radium on the hemapoeitic system of laboratory animals was studied in different concentrations and exposure time. Irreversible changes of the blood count and in the bone marrow were found. They can be explained with an effect on hormonal factors, principally those produced by the hypophysis and the adrenal cortex. The possibility of a direct radiation effect causing irreversible changes in the bone marrow was discussed. It was pointed out that the therapeutic use of radium of short duration is harmless. (auth)

Radiation Sickness

17777 JPRS-2298

THE EFFECT OF IRRADIATION ON THE COURSE OF THE VACCINAL PROCESS CAUSED BY THE ADMINISTRATION OF LIVE BRUCELLOSIS VACCINE TO ANIMALS. Z. V. Shetsova. Translated from Med. Radiol. 4, No. 10, 46-53(1959). 11p. OTS.

Vaccination of white rats and guinea pigs with a live

brucellosis vaccine during the height of radiation sickness increased the mortality rate of the irradiated animals. A marked inhibition of agglutinin formation was demonstrated in the irradiated animals. (C.H.)

17778 JPRS-2400(p.26-34)
THE STATE OF THE GASTROINTESTINAL TRACT IN ACUTE RADIATION SICKNESS CAUSED BY THE ADMINISTRATION OF RADIOACTIVE STRONTIUM (MORPHOLOGIC STUDY). G. A. Lebedeva. Translated from Med. Radiol. 4, No. 2, 29-35(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14183.

17779 JPRS-2400(p.35-8)
THE CONTENT OF AMINO NITROGEN IN THE ORGANS OF RATS IN THE DEVELOPMENT OF RADIATION SICKNESS. T. A. Fedorova. Translated from Med. Radiol. 4, No. 2, 35-7(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14184.

17780 JPRS-2400(p.39-45)
LIPOPROTEINS OF THE MITOCHONDRIA OF LIVER CELLS IN ACUTE RADIATION SICKNESS. V. D. Blokhina Translated from Med. Radiol. 4, No. 2, 37-41(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9623.

17781 JPRS-2400(p.46-57)
CERTAIN PECULIARITIES IN THE INFLAMMATORY REACTION OF THE PERITONEUM IN ACUTE RADIATION SICKNESS. V. I. Ponomar'kov. Translated from Med. Radiol. 4, No. 2, 42-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14186.

17782 JPRS-2400(p.65-70)
CHANGES IN PULMONARY PHAGOCYTES IN RADIATION SICKNESS IN RABBITS. A. E. (Ye.) Ivanov. Translated from Med. Radiol. 4, No. 2, 59-62(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14189.

17783 JPRS-2400(p.71-3)
THE CONTENT OF TOTAL IRON IN THE PLASMA OF DOGS UPON THE DEVELOPMENT OF ACUTE RADIATION SICKNESS. D. A. Golubentsev. Translated from Med. Radiol. 4, No. 2, 78-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14191.

17784 JPRS-2400(p.74-5)
EXPERIMENTAL TUBERCULOSIS IN IRRADIATION. V. A. Solov'eva (Solov'yeva). T. A. Khudushina, N. M. Makarevich, and M. M. Averbakh. Translated from Med. Radiol. 4, No. 2, 79(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14192.

17785
IMMUNO-ELECTROPHORETIC ANALYSIS OF BLOOD SERUM PROTEINS IN RADIATION SICKNESS. S. S. Vasileiskiĭ, T. A. Fedorova, and E. M. Belyaeva. Biochemistry (U.S.S.R.) (English Translation) 24, 914-16 (1959) Nov.-Dec.

Experiments have shown that in irradiated animals the content of different proteins in the albumin fraction is decreased unequally, and in particular the disappearance or sharp decrease in amount of one of these proteins is shown. The electrophoretic mobility of some serum proteins changes in radiation sickness. (auth)

17786
SOME EXPERIENCES WITH IRRADIATION INJURY. Joseph W. Ferrebee and Donnall Thomas (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Radiology 75, 1-5(1960) July.

Observations on human patients have led to the conclusion that exposures to radiation commonly accepted as lethal need not be so if the patient is properly cared for. It has been demonstrated that bone marrow will regenerate from remnants not completely destroyed by radiation at doses of 800 to 1,000 r, provided the patient receives prompt supportive treatment. This consists chiefly of fresh blood and antibiotics with isolation to reduce the possibility of death from infectious disease. The case histories of human patients are reviewed. Results are described following infusion of isologous marrow in man. Good results are reported for dogs treated with autologous marrow removed prior to exposure to doses of 1,000 to 1,500 r radiation. Good results are also reported for dogs treated with homologous grafts of marrow after exposure to radiation doses up to 2,000 r. It is suggested that in both man and dogs homologous marrow is readily accepted after high-level radiation exposure. (C.H.)

17787
SOME FACTORS ALTERING THE SEVERITY OF ACUTE RADIATION PNEUMONITIS: VARIATION WITH CORTISONE, HEPARIN, AND ANTIBIOTICS. William T. Moss, Francis J. Haddy, and Sanford K. Sweany (Chicago Wesley Memorial Hospital). Radiology 75, 50-4 (1960) July.

The effect of steroids, heparin, and antibiotics upon radiation lung damage was studied in rats. Total chest compliance, the relation of pressure to volume, was selected as the measure of damage. Irradiation decreased compliance. This change was unaffected by heparin but was questionably prevented by antibiotics. Cortisone definitely reduced the severity of acute radiation-induced lung damage. (auth)

17788
THE RELATIONSHIP BETWEEN OXYGEN TENSION OF INHALED GAS AND THE SEVERITY OF ACUTE RADIATION PNEUMONITIS. William T. Moss and Francis J. Haddy (Chicago Wesley Memorial Hospital). Radiology 75, 55-8(1960) July.

Lung compliance is decreased by radiations. The change is less severe if the animal is irradiated at high O_2 tensions. It was also found that the adrenals were heavier in the high O_2 group than in the low O_2 group. It is suggested that the severe skin and marrow reaction produced in the high O_2 group results in adrenal hyperplasia with the increased production of endogenous cortisone and the subsequent suppression of compliance changes. (auth)

CHEMISTRY

General and Miscellaneous

17789 CF-58-1-137
Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS

SECTION MONTHLY PROGRESS REPORT [FOR] JANUARY 1958. J. C. Bresee, P. A. Haas, C. D. Watson, and M. E. Whatley. Aug. 12, 1958. 41p. OTS.

Absolute calibration of neutron yields from a polonium nitrate-fluorocarbon interface gave 8 neutrons/min, sq cm, mc/ml. In two Fluorox fluidized bed reactor runs UF_6 recoveries of 47 and 70% theoretical were attained. Washing and descaling operations for Loop P-1 have been completed. Preliminary studies of ThO_2 classification by hydroclones showed that particles as small as 0.5 micron could be classified. Continuous, self-sustaining operation of the Darex dissolver, stripper, and reflux condenser was maintained during a 48-hr period. Uranium losses to the sublimate were less than 0.1% in a 24 hr Zircex run. A 32 hr dissolution run was completed in which a fuel element fabricated of Zircaloy-3 was dissolved in a $NaF-ZrF_4$ fused salt. (auth)

17790 CF-60-6-48

Oak Ridge National Lab., Tenn.

THE REACTION BETWEEN SULFURIC ACID AND ALIPHATIC HYDROCARBONS. AMSCO 125-82. Willis H. Baldwin. June 8, 1960. 9p. Contract [W-7405-eng-26]. OTS.

Concentrated sulfuric acid is regularly used to remove unsaturated hydrocarbon impurities from saturated aliphatic hydrocarbons. The reaction between concentrated sulfuric acid and saturated aliphatic hydrocarbons is not so well known. A survey of the chemical literature was found to include studies that show several relatively slow reactions. Isotopic exchange with D_2SO_4, racemization of optically active alkanes, isomerization, cleavage to alkanes of lower molecular weight, combination to compounds of higher molecular weight and the formation of SO_2 were recognized. Amsco 125-82, the diluent used in solvent extraction, reacts with sulfuric acid forming sulfur dioxide and low boiling hydrocarbon fragments. The over-all reaction probably results in the formation of more stable hydrocarbons by rearrangement. The sulfuric acid treatment can thus produce a more desirable diluent. (auth)

17791 HW-36427

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PUREX—A HANFORD SEPARATIONS PLANT. W. J. Mundt. Apr. 29, 1955. Decl. May 12, 1960. 5p. OTS.

A description of Purex plant is given. Included are discussions of the Purex Process and nuclear safety. (J.R.D.)

17792 IDO-14505

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

MECHANISM OF ELECTROREDUCTION OF CHROMIC ION AT THE MERCURY CATHODE. M. E. McLain, Jr. May 20, 1960. 55p. Contract AT(10-1)-205. OTS.

The mechanism of reduction for chromium(III) ion to chromium(II) at the mercury cathode was studied in 0.1M KNO_3. Data obtained at varying temperature and solution composition from polarograms gave values for ΔH^*, ΔS^*, and ΔF^* which indicated that two mechanisms were involved. At potentials more positive than the polarographic half-wave potential, the mechanism appeared to be simple electron transfer from the electrode to the chromium(III) ion in solution. When the potential was more negative than the half-wave, potential electron exchange between the reduced chromium ion near the electrode surface and a chromium(III) ion in solution became appreciable. Values for the heat of activation for the reduction of chromium(III) to chromium(II) in 0.1M KNO_3 for the electron transfer and exchange reaction mechanisms were determined to be 34.7 and 27.0 kcal $mole^{-1}$, respectively. (auth)

17793 KAPL-1620

Knolls Atomic Power Lab., Schenectady, N. Y.

REPORT OF THE CHEMISTRY AND CHEMICAL ENGINEERING SECTION FOR AUGUST, SEPTEMBER, OCTOBER 1956. Decl. May 3, 1960. 105p. Contract W-31-109-Eng-52. OTS.

Studies were continued on the following: waste treatment, mixed oxide reactor fuel, nuclear chemistry, liquid metal fuel suspensions, water technology, high temperature processing, and fuel heat transfer studies. (For preceding period see KAPL-1573.) (W.L.H.)

17794 NP-8819

General Electric Co. General Engineering Lab., Schenectady, N. Y.

SYNTHESIS AND EVALUATION OF THERMALLY STABLE POLYMERS. PHASE I. POLYMER SYNTHESIS. G. P. Brown and A. Goldman. PHASE II. POLYMER EVALUATION. Charles D. Doyle. Progress Report No. 1 [for] March 1, 1960 to June 1, 1960. 33p. Project No. 0-(7-7340). Contract AF33(616)-7076.

Synthesis directed toward the preparation of m-polyphenyl ethers via self-condensation of the potassium salt of m-bromophenol is under way. No successful polymers were prepared due to a high percentage of carbon-carbon coupling reactions. Concluding studies of thermal stability are reported. Methods are proposed for the future evaluation of promisingly stable experimental polymers. (auth)

17795 ORNL-2931

Oak Ridge National Lab., Tenn.

REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1960. 206p. Contract W-7405-eng-26. OTS.

Molten-Salt Reactor Program. Phase diagrams for many fluoride systems of interest as fuels, blankets, or coolants for nuclear reactors or as fuel reprocessing media were prepared from data obtained by a variety of techniques. The new compounds discovered in the course of molten-salt phase studies include 21 binary and ternary fluoride compounds whose compositions, optical properties, and x-ray-diffraction patterns are presented. Plutonium was shown to exhibit sufficient solubility in molten fluoride systems to be of interest as a potential reactor fuel. A systematic study of the solubilities of the noble gases in molten salts was undertaken because of the occurrence of these gases as fission products of high neutron-absorption cross section. Studies of the thermodynamic behavior of structural-metal corrosion products in fluoride melts were extended to include CrF_2 in $NaF-ZrF_4$ and NiF_2 in $LiF-BeF_2$. The depressions of the freezing point of NaF upon the addition of alkali-metal fluorides, alkali-earth fluorides, and transition-metal difluorides were measured and correlated with theories of molten-salt behavior. The vapor pressure of liquid UF_4 over the temperature interval 1018 to 1302°C was measured. Self-diffusion of chromium in nickel-based alloys in contact with molten fluorides was studied by use of radiotracer Cr^{51}. Molten mixtures of LiF and BeF_2 with ThF_4 and UF_4 were purified by treatment in the molten state at 800°C with H_2 to reduce SO_4^{2-} and higher valence states of uranium, with anhydrous HF to remove Cl^- and S^{2-} and to convert oxides and oxyfluorides to fluorides, and with H_2 again to reduce Fe^{2+}, Ni^{2+}, or Cu^{2+} to the metallic state. Molten fluorides containing $LiF-BeF_2-UF_4-ThF_4$ do not react chemically with graphite. Graphite is not wetted by molten $LiF-BeF_2-ThF_4-UF_4$ mix-

tures. Adsorption of xenon on graphite was measured over the temperature interval from −79 to +80°C; extrapolations of the data suggest that less than 1×10^{-5} cm^3 (STP) of xenon per gram of graphite could be adsorbed at 500°C and a xenon pressure of 1 mm. The irradiation of molten salts in contact with graphite or Inconel has not revealed any substantial corrosion or damage attributable to the effect of radiation. Nuclearly harmful rare-earth fission products such as Sm^{3+} can be selectively removed from molten fluoride solution by exchange with a solid bed of CeF_3; the solubility of CeF_3 in the molten fluoride is sufficiently low to permit use of such a process for removal of rare earths from an operating reactor. Selective precipitation of oxides by use of reagents such as H_2O, BeO, CaO, or possibly ThO_2 from molten fluoride reactor fuels was demonstrated. Studies of recovery of uranium and protactinium by precipitation with BeO or ThO_2 are in progress. Aqueous Homogeneous Reactor Program. A general description of the solid-liquid equilibria at 300°C for the UO_3-CuO-NiO-SO_3-H_2O system and its included four- and three-component systems was obtained by determining solubilities as functions of SO_3 concentration under conditions in which one, two, or three solid phases were in equilibrium with the solution. Compositions of light and heavy phases in the system UO_3-SO_3-H_2O and its D_2O counterpart were established at 300 and 350°C. Temperatures of formation of two liquid phases were determined in the system UO_3-SO_3-N_2O_5-H_2O. The system UO_3-N_2O_5-H_2O was investigated at 25°C and from 150 to 350°C. The effectiveness of cupric nitrate as a soluble homogeneous catalyst for the recombination of radiolytic gas in uranyl nitrate solutions was measured and found to be about 40% of that of cupric sulfate in sulfate-based aqueous homogeneous reactor fuel solutions. In connection with studies of the hydrolysis of U(VI) and sulfate ions, an experimental program was initiated to measure acidity in aqueous solutions at elevated temperatures. The isopiestic method for the study of electrolyte solutions at elevated temperature was extended to seven representative 1-1, 1-2, 2-2, and 2-1 solutes at 99.6°C at reference NaCl concentrations above 1 m. Gas-Cooled Reactor Program. The volumes and compositions of the gases evolved from six reactor grades of graphite were determined by outgassing techniques which included two methods of heating the graphite (external resistance or internal induction) and the use of temperatures as high as 2000°C. The expectation that the transport of reactor coolant gases and fission product poison gases through ceramic fuel elements and graphite moderator bodies will become important for the development of high-performance reactors led to the initiation of a program of theoretical and experimental study of porosity, forced gas flow, and diffusion. Thermodynamic calculations suggested that cesium and rubidium (long-lived fission products formed in high yield) would appear in the EGCR fuel-element capsules both as free metals at moderate partial pressures and as compounds with the nonmetals (Br, I, Se, and Te). The irradiation of cylindrical specimens of BeO in the ETR at neutron fluxes (thermal and fast) of about 5×10^{14} under conditions of thermal stress has not so far revealed any noticeable mechanical damage to this moderator material. Dissociating gases were proposed for possible use as reactor heat transfer media and thermodynamic working fluids. Calculations indicated that aluminum chloride has an equilibrium (monomer ⇌ dimer) which is suitable for use within the temperature and pressure limitations currently associated with gas-cooled reactors. Corrections for thermocouples used to measure the temperatures of gas-cooled surfaces were determined experimentally and correlated with the flow characteristics of the cooling gas by means of a theoretical analysis and computations on the Oracle. A review was prepared of all previous studies of the removal of radioactive gaseous fission products from other gases. The removal of radioiodine vapor from air streams was studied extensively. A number of proposed fission-gas or iodine adsorption systems were reviewed for technical feasibility and safety. Preparation of Reactor-Grade Materials. As part of a joint chemical-metallurgical program, preliminary laboratory-scale and intermediate-scale demonstrations were made of a process for removing oxygen from yttrium-bearing fluoride salts by hydrofluorination in the liquid state. A number of fluorides of chromium were prepared as a consequence of interest in the corrosion of chromium alloy containers by molten-fluoride reactor fluids. The chemistry of high-temperature oxide systems of interest to reactor programs was approached initially by a study of the limits of precision and accuracy available in chemical methods for ascertaining the oxygen/uranium ratios in uranium oxides. Improvements were made in processes for preparing beryllium oxide of high purity; the sintering characteristics of the product were found to depend on the method of preparation and the calcium and silica content. (auth)

17796 TID-6170

Utah. Univ., Salt Lake City.

CALCULATED AND EXPERIMENTAL PROPANE MASS SPECTRA, DEPENDENCE UPON ELECTRON VOLTAGE AND SAMPLE TEMPERATURE. Technical Report No. VIII. Edward M. Eyring and Austin L. Wahrhaftig. May 15, 1960. 86p. Project No. 5. Contract AT(11-1)-82. OTS.

The experimental mass spectra of propane obtained using a mass spectrometer which permits the study of ion formation and dissociation processes under electron bombardment are described. The spectra were obtained with 14 to 500 electrons. A semiquantitative fit of the experimental data was obtained. Other applications are discussed. (J.R.D.)

17797 UR-559

Rochester, N. Y. Univ. Atomic Energy Project.

EQUILIBRIUM CONSTANTS FOR THE FORMATION OF POLYNUCLEAR TRIDENTATE 1:1 CHELATES IN URANYL-MALATE, -CITRATE, AND -TARTRATE SYSTEMS. DEFORMATION OF THE URANYL ENTITY. Isaac Feldman, Carol A. North, and Hugh B. Hunter. Oct. 12, 1959. 33p. Contract W-7401-eng-49. OTS.

pH titrations were analyzed to determine the over-all dimerization constants, K_{III}, and the trimerization constants, K_{Tr}, for the tridentate 1:1 chelates in the uranyl-malate, -citrate, and -d-tartrate systems at 25°C. For these three systems, respectively, $\log_{10}K_{III}$ was found to be 7.76, 7.68, and 5.54 (±0.04 in each case) at $\mu = 0.136$ and 9.08, 9.04, and 6.76 (±~0.05) at infinite dilution. At $\mu = 0.20$, pK_{Tr} was 10.56 ± 0.05 for the uranyl-malate system and 9.7 ± 0.12 for the uranyl-d-tartrate system. The unexpected increase in the tendency of uranium to polymerize after tridentate chelation is explained on the basis of decreased 5f orbital participation in the uranium to oxygen bonds of the uranyl entity as a result of deformation of the normally-collinear uranyl entity. The fact that relative to the uranyl-malate system the uranyl-d-tartrate system has a lower K_{III} but higher K_{Tr} is believed due to more hydrogen bonding plus greater inductive effect in the tartrate ion than in malate ion. In accord with these hypotheses, the equimolar uranyl-meso-tartrate system seems to contain a mixture of unhydrolyzed mononuclear bidentate chelate and olated binuclear tridentate chelate. (auth)

17798 AEC-tr-4102

THE PRINCIPLE OF HOMOLOGY IN CHEMISTRY. HOMOLOGY IN ORGANIC AND INORGANIC CHEMISTRY. C. G. Bedreag. Translated from Acad. rep. populare Romîne, Filiala Iaşi Studii cercetări ştiint. 5, No. 1/2, 215-20(1954). 5p. JCL.

Two basic problems in the field of chemistry were discussed at the Karlsruhe Chemical Congress held in 1861. These discussions were on "The Atomic Theory" and the homologous series in organic chemistry. An abstract is included of an 1861 paper by Bacaloglu on "Theoretical Considerations of the Homologous Series." In 1869 the two problems of the congress merged through two different paths, both paths being based on the atomic weights of the elements. In 1915, the arrangement of the 14 rare earths was accomplished on the basis of the concept of atomic number Z. These elements were placed in a new column of elements (the 19th) exhibiting similar chemical behavior, i.e., degree of oxidation IV—III, thus forming a single new homologous family, organic in nature. In the period 1920 to 1926, the Cu, Ag, Au group was separated from the alkalines by the complex spectrum of copper. The 20th column was composed following the synthesis of elements 93 and 94 which have a degree of oxidation VI, IV (like uranium but with different behavior). This group is located after uranium(VI) but before rhenium(VII) and is called the "uranides." Parallelism is established between the rare earths and the uranides with internal f electrons. (B.O.G.)

17799 UCRL-Trans-516(L)

THE COMPLEX FORM OF TETRAVALENT CERIUM WITH ACETATE- AND OXALATE-IONS. D. S. Ryabchikov and N. S. Vagina. Translated by Esther Goldberg from Zhur. Neorg. Khim. 2, 2109-14(1957). 10p. JCL or LC.

It is established that Ce(IV) forms a more stable complex with acetate and oxalate ions than trivalent lanthanides. Methods for recovering cerium with 97 to 98% recovery are reviewed. (C.J.G.)

17800

MAGNETIC INVESTIGATIONS OF SPIN-FREE COBALTOUS COMPLEXES. III. ON THE EXISTENCE OF PLANAR COMPLEXES. F. Albert Cotton and Richard H. Holm (Massachusetts Inst. of Tech., Cambridge). J. Am. Chem. Soc. 82, 2979-83(1960) June 20.

Magnetic and spectral data are presented for 14 spin-free complexes of Co(II) which are either quadricoördinate or which have a tetragonally distorted octahedral coördination shell; in all cases but one all donor atoms are oxygen. It is concluded that the quadricoördinate complexes are planar. Planar and spin-free quadricoördinate complexes of Co(II) have not heretofore been generally recognized. (auth)

17801

SULFOXIDES AS LIGANDS. I. A PRELIMINARY SURVEY OF METHYL SULFOXIDE COMPLEXES. F. A. Cotton and R. Francis (Massachusetts Inst. of Tech., Cambridge). J. Am. Chem. Soc. 82, 2986-91(1960) June 20.

The preparation of a large number of complexes of dimethyl sulfoxide is reported. The structures of some of them were elucidated on the basis of infrared and visible spectra, magnetic measurements, and steric considerations. It appears that oxygen is the donor atom in all cases reported except toward Pd(II) in $[(CH_3)_2SO]_2PdCl_2$ where infrared evidence suggests Pd ← S bonding. Some of the complexes, such as $[(CH_3)_2SO]_2SnCl_4$ and $[(CH_3)_2SO]_2FeCl_3$, have great thermal stability. $NiCl_2 \cdot 3[(CH_3)_2SO]$, $CoCl_2 \cdot 3[(CH_3)_2SO]$ and $CoBr_2 \cdot 3[(CH_3)_2SO]$ are shown to contain, respectively, the tetrahedral anions $NiCl_4^{2-}$, $CoCl_4^{2-}$ and $CoBr_4^{2-}$. (auth)

17802

METAL BINDING OF THE BENZIMIDAZOLES. Thomas J. Lane and Kenneth P. Quinlan (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc. 82, 2994-7(1960) June 20.

The acid dissociation constants were determined potentiometrically for benzimidazole, 2-methylbenzimidazole and 2-ethylbenzimidazole in solutions of ionic strength 0.16 M ($NaNO_3$) at 4 ± 1, 25 ± 0.1, and 35 ± 0.1°C. The changes in enthalpy, ΔH^0, were found to be 8.7, 9.8, and 9.3 kcal/mole, respectively. Formation constants were determined for copper(II) with benzimidazole by the Bjerrum potentiometric method in solutions of the same ionic strength at the three above temperatures. An upper limit of the value of the formation constant for copper(II) and 2-methylbenzimidazole at 4°C is reported. The formation constants for cadmium with benzimidazole and 2-methylbenzimidazole were determined by the polarographic method in 50% aqueous ethanol at 25 ± 0.1°C. Results indicate that the benzene portion of the benzimidazole hinders coördination with copper(II). Formation constants of copper(II) with 2-hydroxymethylbenzimidazole and 1-methyl-2-hydroxymethylbenzimidazole show that the unsaturated nitrogen is the active site in the substituted benzimidazoles. (auth)

17803

STABILITY CONSTANTS OF VARIOUS METAL IONS WITH THE 2-HYDROXYMETHYLNAPHTHIMIDAZOLES. Thomas J. Lane and Kenneth P. Quinlan (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc. 82, 2997-9(1960) June 20.

The acid dissociation constants of 2-hydroxymethylnaphth[1,2]imidazole and 2-hydroxymethylnaphth[2,3]-imidazole and the stability constants of their chelates with various metal ions were determined in 50% aqueous dioxane by the potentiometric titration method. The preparations of the 2-hydroxymethylnaphthimidazoles by the Phillips method are described. The 2-hydroxymethylnaphth[2,3]imidazole chelates of the divalent metal ions are more stable than the 1,2 isomer chelates. The difference is explained by the steric hindrance of the neighboring hydrogen atoms. (auth)

17804

REACTIONS OF ALKOXY RADICALS. VII. THE ETHOXY RADICAL. M. H. J. Wijnen (Mellon Inst., Pittsburgh). J. Am Chem. Soc. 82, 3034-40(1960) June 20.

The photolysis of ethyl propionate was reinvestigated. The reactions of ethoxy radicals, produced in the primary process, were studied in detail. Information regarding these reactions was obtained: (1) $C_2H_5O + C_2H_5 \rightarrow C_2H_5OC_2H_5$, (2) $C_2H_5O + C_2H_5 \rightarrow C_2H_6 + CH_3CHO$, (3) $C_2H_5O + C_2H_5 \rightarrow C_2H_4 + C_2H_5OH$, (4) $C_2H_5O \rightarrow CH_3 + CH_2O$, and (5) $C_2H_5O + C_2H_5COOC_2H_5 \rightarrow C_2H_5OH + R$. At 29°C, $k_2/k_1 = 1.3 \pm 0.2$ and $k_3/k_1 = 2.3 \pm 0.3$ indicating that disproportionation reactions between ethoxy and ethyl radicals are more important than their recombination reactions. Activation energies of 13 and 5.5 kcal were obtained for reactions 4 and 5, respectively. (auth)

17805

ARYLBORONIC ACIDS. V. METHYL-SUBSTITUTED BORONIC ACIDS, BORINIC ACIDS AND TRIARYLBORONS. Richard T. Hawkins, William J. Lennarz, and H. R. Snyder (Univ. of Illinois, Urbana). J. Am. Chem. Soc. 82, 3053-9 (1960) June 20.

A number of arylboron compounds bearing o- and p-methyl substituents are prepared and studied. Whereas 2,6-dimethylbenzeneboronic anhydride is shown by molecular weight determinations to be a trimer, mesityleneboronic anhydride is a dimer, for which a four-membered boron—oxygen ring is proposed. The former yields a

complex with pyridine, but only spectral evidence for a pyridine–mesityleneboronic anhydride complex is noted. Under mild conditions, dimesitylenеboronic acid is not dehydrated nor is the anhydride hydrated to the acid. Trimesitylboron is nitrated to yield a hexanitro derivative. 2-Mesityl-1,3-dihydro-2,1,3-benzoboradiazole, prepared from mesitylenеboronic acid and o-phenylenediamine, is shown to be more resistant to cleavage by hydrochloric acid than is the 2-phenyl homolog. The preparation of 6-methylboronophthalide and some proton magnetic resonance studies of arylboron compounds are reported. (auth)

17806

POLYPHOSPHORIC ACID AS A REAGENT IN ORGANIC CHEMISTRY. X. TWO YELLOW HYDROCARBONS FROM ACETOPHENONE. Roger W. Roeske, D. Bruce Bright, R. L. Johnson, W. J. DeJarlais, Richard W. Bush, and H. R. Snyder (Univ. of Illinois, Urbana). J. Am. Chem. Soc. 82, 3128-33(1960) June 20.

The action of polyphosphoric acid on acetophenone produces two crystalline yellow hydrocarbons (A and B) of the formula $C_{32}H_{24}$; other products isolated are benzoic acid, dypnone, and a yellow substance (C) melting above 300°. The lower-melting yellow hydrocarbon (A) is isomerized to a colorless hydrocarbon (D). Studies of the reactions and spectra of A and D are made and structures are suggested for these hydrocarbons. (auth)

17807

PURINE N-OXIDES. VIII. N-OXIDES OF AZAPURINES. Marcus A. Stevens, Herman W. Smith, and George Bosworth Brown (Sloan-Kettering Inst. for Cancer Research, New York and Cornell Univ. Medical Coll., New York). J. Am. Chem. Soc. 82, 3189-92(1960) June 20.

Comparisons were made between the behavior of adenine 1-N-oxide and the behavior of the N-oxides of the azaadenines in which the 2- and/or 8-methylidyne groups are replaced by aza groups. 8-Azaadenine is oxidized by peroxyacetic acid to a 1-N-oxide. 2-Azaadenine is oxidized to two hydrolytically stable N-oxides. The structure of the 2-azaadenine N-oxide formed in larger amount is proved to be a 1-N-oxide by an alternative synthesis from 4-aminoimidazole-5-carboxamidoxime and nitrous acid. The structure of the other is unknown. The ribosyl derivative of 4-aminoimidazole-5-carboxamidoxime, obtained by the alkaline hydrolysis of adenosine 1-N-oxide, yields 2-azaadenosine 1-N-oxide with nitrous acid. 8-Azaadenine 1-N-oxide, like adenine 1-N-oxide, exhibits hydrolytic instability in the 6-membered ring and yields 4-aminotriazole-5-carboxamidoxime. This latter gives the corresponding carboxamide and carboxamidine upon hydrolysis and hydrogenation, respectively. Upon direct nitrosation this carboxamidoxime yields 2,8-diazaadenine 1-N-oxide. The oxime of the hydrolysis product of 6-methylpurine 1-N-oxide, 4-acetyl-5-aminoimidazole, gives 6-methyl-2-azapurine 1-N-oxide upon nitrosation. (auth)

17808

PURINE N-OXIDES. IX. POLAROGRAPHIC STUDIES. Francis A. McGinn and George Bosworth Brown (Sloan-Kettering Inst. for Cancer Research, New York and Cornell Univ. Medical Coll., New York). J. Am. Chem. Soc. 82, 3193-5(1960) June 20.

The polarographic behaviors of adenine 1-N-oxide, adenosine 1-N-oxide, 2-azadenine, 2-azaadenine 1-N-oxide, 2,6-diaminopurine and 2,6-diaminopurine 1-N-oxide were examined at various pH's. Only with the first two was there a discrete reduction potential attributable to the N-oxide function. Adenine 1-N-oxide and 2-azaadenine 1-N-oxide can be reduced electrolytically to adenine and 2-azaadenine, respectively. (auth)

Analytical Procedures

17809 BAW-1099

Babcock and Wilcox Co. Research Center, Alliance, Ohio.
LIQUID METAL FUEL REACTOR EXPERIMENT; CHEMICAL ANALYTICAL PROCEDURES. May 1960. 222p. Contract AT(30-1)-1940. OTS.

Chemical analytical procedures were developed for the determination of U, Zr, Fe, Mn, silica, P, C, chlorides, oxides, Th, Mg, and Cr in Bi, N_2 and AlN in steel, and Al in chromium steel. (C.J.G.)

17810 HW-57464

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DETERMINATION OF TOTAL URANIUM AND U^{235} IN Al–U FUEL ELEMENTS. W. L. Delvin, H. E. Palmer, and U. L. Upson. Sept. 16, 1958. Decl. Apr. 28, 1960. 22p. Contract W-31-109-Eng-52. OTS.

Uranium–aluminum alloy fuel elements containing three to five per cent enriched uranium were analyzed both for total uranium content and for degree of enrichment (approximately 93 per cent U^{235}). Each fuel element was reduced to wafers and turnings which were dissolved in HCl and bromine. For the total uranium analysis, the uranium was reduced in a Jones reductor and re-oxidized with excess standard ceric sulfate, with subsequent back-titration of the excess ceric ion against standard ferrous sulfate. A correction for iron interference was necessary. The precision of this method is ±0.3 per cent at the 95 per cent confidence level. For isotopic analysis, the uranium solutions were gamma counted in the 0.174 to 0.194 Mev interval, without chemical separation, and evaluated relative to mass spectrometer–calibrated standards. Corrections for both uranium and aluminum chloride concentrations were applied. Over-all counting precision is ±0.4 per cent or better. The reported isotopic concentrations were derived from the total uranium analysis and the gamma counting data, and are precise to ±0.5 per cent. (auth)

17811 NBL-159

New Brunswick Lab., AEC, N. J.
SEMI-ANNUAL PROGRESS REPORT FOR THE PERIOD JULY 1959 THROUGH DECEMBER 1959. May 1960. 115p. OTS.

A tentative procedure for the determination of U^{3+} in materials containing UF_3, U, and UF_4 by hydrogen evolution is described. A method is described for the determination of metallic U in U_3O_8 by hydrogen evolution. A fluorimetric method is reported for the determination of microgram quantities of U in Be metal. A rapid method is presented for the spectrochemical determination of B in pure graphites. A high precision method for the determination of U is reported in detail. The preparation and study of Pu $(SO_4)_2 \cdot 4H_2O$ for use as a primary analytical standard are reported. Microgram quantities of Fe were separated from Pu by anion exchange and determined colorimetrically with ortho-phenanthroline. A method is described for the determination of U^{235} in a variety of U containing materials by means of gamma spectrometry. The instrumentation and analytical technique used in the mass spectrometric determination of the isotopic abundance of U samples are briefly described. (For preceding period see NBL-156.) (W.L.H.)

17812 ORO-279
Kentucky. Univ., Lexington.
AN INVESTIGATION OF THE SPECTROGRAPHIC ANALYSIS OF HIGH PURITY RARE EARTH OXIDES (thesis). Yoshio Garrick Ishida. 1959. 79p. Contract [AT(40-1)-2124]. OTS.

An investigation of the spectrographic analysis of high purity rare earths containing trace amounts of other rare earths was made. The study was conducted in a controlled atmosphere of 1:4 oxygen-argon using d-c arc excitation. Working curves and limits of detection were determined for Dy, Gd, and Tb in a Y matrix; for Er, Lu, and Tm in a Yb matrix; for Dy, Er, and Y in a Ho matrix; for Pr, Sm, and Eu in a Nd matrix. In a Dy matrix, the minimum detectabilities of Y, Tb, and Ho were found. The concentrations of the impurities covered in the working curves ranged from 0.005 to 2.00%. The average precision of the determinations was below 8%. The order of volatility of the rare earth oxides in the 1:4 oxygen-argon atmosphere was observed. The volatility was found to increase as the heats of vaporization of the rare earths decreased. Neodymium was the only rare earth studied which showed a discrepancy in the correlation between volatility and heat of vaporization. Working curves and limits of detection were determined for Dy and Ho employing a copper electrode-interrupted discharge method. Concentrations from one microgram per milliliter to sixty micrograms per milliliter of the rare earth oxides were used in the construction of the working curves. The average precision was below 5% for the working curves. A proposed method of calculating concentration ratios was tested and found to give good accuracy in determining the relative amounts of Dy and Ho present in a series of samples. The sensitivities of the controlled atmosphere d-c arc and copper electrode-interrupted discharge methods were compared. The sensitivity in detecting absolute amounts of rare earths was of the same magnitude for the two methods. In terms of relative amounts, the sensitivity of detection of the d-c arc method was superior to that of the copper electrode method. (auth)

17813 PGR-103(W)
United Kingdom Atomic Energy Authority. Production Group. [Chemical Services Dept.]. Windscale, Sellafield, England.
ANALYTICAL METHOD FOR THE ASSAY OF UREA. Apr. 1960. 3p. BIS.

The sample is converted to ammonium sulfate by the Kjeldahl method. The ammonia is then distilled into acid the excess of which is back-titrated with standard alkali. (auth)

17814 TID-6071
Los Alamos Scientific Lab., N. Mex.
SPECTROPHOTOMETRIC DETERMINATION OF SILICON IN PLUTONIUM. Maynard E. Smith. [1957?]. Decl. July 9, 1958. 17p. OTS.

A spectrophotometric procedure is described for the determination of silicon in plutonium metal or solutions. Using this procedure the standard deviation determined for 54 simulated samples containing 25 to 100 ppm silicon varied from 10 to 5 relative %, respectively. A preliminary separation of the plutonium is made by precipitating the insoluble plutonium(III) fluoride. After removal of the plutonium precipitate, the silicon is determined by a spectrophotometric procedure based on the formation of silicomolybdic acid and its reduction to the blue complex. Aluminum chloride rather than boric acid is used to complex the fluoride and prevent its interference in the color formation. Preliminary data show that the method with slight modification may also be used to determine silicon in bismuth, lead, magnesium, and uranium and suggested procedures are given. The time for duplicate analysis is approximately 3 hours. (auth)

17815 UCRL-Trans-533
PRELIMINARY RESULTS OF A LUMINESCENT-BITUMINOLOGOUS ANALYSIS OF FOUR CARBONACEOUS CHONDRITES. G. P. Vdovykin. Translated by Esther Goldberg from Meteoritika 18, 78-82(1960). 6p. JCL or LC.

A luminescent-bituminologous analysis of bitumens of four stone meteorites was made. The method consisted of cold extraction of bitumens successively by four organic solvents: petroleum ester, chloroform, alcohol-benzene, and 2% solution of KOH. The quantitative content of bitumen recovered varied from 0.0159 to 0.0713%. (C.J.G.)

17816
SPECTROPHOTOMETRY OF THORIUM WITH THORON IN THE PRESENCE OF ZIRCONIUM. E. Cerrai and F. Gazzarrini (Centro Informazioni Studi Esperienze, Milan). Energia nucleare (Milan) 7, 358-60(1960) May. (In Italian)

The determination of thorium in the presence of zirconium by the use of thoron was investigated. The zirconium was masked by the addition of hydrogen peroxide which forms peroxide complexes with the zirconium. The experiments gave satisfactory results. The experimental conditions are described in detail. (J.S.R.)

17817
SIMULTANEOUS DETERMINATION OF STRONTIUM AND CALCIUM IN URINE AND SERUM BY FLAME SPECTROPHOTOMETRY. Georgio de Angelis and Gianfranco Mazzuoli (Università, Rome). Ital. J. Biochem. 8, 319-33(1959) Nov.-Dec. (In English)

A method is described for the simultaneous determination of strontium and calcium in urine and serum samples. The method consists in deproteinizing the biological fluids, precipitating calcium and strontium oxalates, dissolving the precipitates in hydrochloric acid, and measuring the emission in a flame spectrophotometer at the following pairs of wavelengths: 423-461 mμ and 622-681 mμ. By subtracting the emission of calcium (the quantity of which is obtained at 423 mμ or 681 mμ) from the total emission measured at the strontium wavelength (461 or 681 mμ), one can obtain the strontium quantities within an average error of 0.2 μg/ml (0.04 mg/100 ml of serum when the quantity of the element varies from 0 to 10 μg/ml (0 to 2 mg/100 ml of serum). At 423-461 mμ better results are obtained. (auth)

17818
SIMULTANEOUS SPECTROPHOTOMETRIC DETERMINATION OF ALUMINUM AND IRON IN URANIUM WITH 8-HYDROXYQUINOLINE (OXINE). Kenji Motojima and Kimie Izawa (Japan Atomic Energy Research Inst., Tokyo). J. Atomic Energy Soc. Japan 2, 253-9(1960) May. (In Japanese)

A simultaneous spectrophotometric method for the determination of aluminum and iron in highly pure uranium is critically examined. Uranium metal is dissolved with hydrochloric acid and potassium chlorate and the solution is heated to expel chlorine and then diluted. An aliquot of the solution containing less than 0.5 g of uranium is used for the analysis. Uranium is masked with either acetic acid at pH 5.5 or ammonium carbonate at pH 9.5 to 10 and oxinates of aluminum and iron are extracted with chloroform at the same time. Then, the extract is washed with a suitable solution to eliminate the interfering metals. By measuring

the absorbances of the extract at 390 and 470 mμ, aluminum and iron are determined. The effects of many elements which are commonly contained in uranium as impurities and the methods for eliminating their interferences are described in detail. By this method, the lower limits of determination are about 2 ppm for aluminum and 5 ppm for iron. (auth)

17819

3-OXIMINOMETHYLSALICYLIC ACID AS AN ANALYTICAL REAGENT. PART II. SPECTROPHOTOMETRIC DETERMINATION OF URANIUM. Asit Kumar Ray and Priyadaranjan Rây (Indian Ass'n. for the Cultivation of Science, Calcutta). J. Indian Chem. Soc. 37, 141-5(1960) Mar. (In English)

The use of 3-oximinomethylsalicylic acid as a reagent for the spectrophotometric determination of uranium(VI), with which it develops an orange-red color in alkaline solution, is described. The wave-length of 400 mμ is found most suitable for absorption measurement. The optimum pH of the solution is at 6.70 to 9.30 with an excess of the reagent, at least 5 to 6 times the molar proportion of uranium, for the maximum development of color. The color is stable at room temperature below 30°C. Beer's law holds good at 7.14 to 119.0 ppm uranium. Sensitivity is 0.12 γU/c.c. The composition (I:I) of the colored species was evaluated by Job's method and the probable constitution suggested. Most cations and anions interfere with the determination of uranium. Hence a preliminary separation of uranium from the interfering ions is essential. (auth)

17820

NON-DESTRUCTIVE ANALYSIS OF MICROGRAM QUANTITIES OF SILVER BY RADIOACTIVATION. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo). Nature 187, 57-8(1960) July 2.

A nondestructive method is described for determining microgram quantities of silver by analysis on a 256-channel pulse-height analyzer following activation in a nuclear reactor. (C.H.)

17821

THE ANALYSIS OF BERYLLIUM AND BERYLLIUM OXIDE. II. THE DETERMINATION OF COPPER. J. O. Hibbits, W. F. Davis, and M. R. Menke (General Electric Co., Evendale, Ohio). Talanta 4, 101-3(1960) Apr.

A method is described for the determination of Cu in Be or BeO by extraction of the neocuproïne complex with methyl isobutyl ketone. The method is accurate to ±5% or ±2.5 micrograms of Cu, whichever is greater. The accuracy and sensitivity could be improved by appropriate choice of sample size, volume of extract and/or cell length. Of the 68 elements investigated, only Au interferes in 10 mg amounts; in this case a slight loss of Cu is caused by occlusion or co-precipitation. (auth)

17822

THE ANALYSIS OF BERYLLIUM AND BERYLLIUM OXIDE. III. THE DETERMINATION OF MOLYBDENUM. J. O. Hibbits, W. F. Davis, and M. R. Menke (General Electric Co., Evendale, Ohio) and S. Kallmann (Ledoux and Co., Teaneck, N. J.). Talanta 4, 104-7(1960) Apr.

A method is described for the determination of Mo by extraction of its thiocyanate complex with methyl isobutyl ketone. The method is accurate to ±4% or ±3 micrograms of Mo, whichever is greater. The accuracy and sensitivity can be improved by appropriate choice of sample size, volume of extract and/or cell length. Of 68 elements investigated, only Re, Pt, Pd, Rh, V, and Te interfere in 10-mg amounts. Of these, only Re interferes seriously. (auth)

17823

SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM IN URANIUM ALLOYS OF THE FISSION ELEMENTS. R. P. Larsen, L. E. Ross, and Gwendolyn Kesser (Argonne National Lab., Ill.). Talanta 4, 108-14(1960) Apr.

Alizarin-Red S was used to determine Zr spectrophotometrically in U alloys of the fission elements. Separation from interferences is effected by co-precipitating the Zr with barium fluosilicate. Color stability and improved precision were realized through changes in the color development procedure. Alloys containing from 1 to 0.01% Zr can be analyzed by this method with coefficients of variation from 1.5 to 20. (auth)

17824

ADVANCES IN ANALYTICAL CHEMISTRY OF U, Th, AND Pu. V. I. Kuznetsov, S. B. Savvin, and V. A. Mikhailov (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Uspekhi Khim. 29, 525-67(1960) Apr. (In Russian)

The chemical methods for determining U, Th, and Pu are reviewed, and analytical reactions with these elements are discussed. 925 references. (R.V.J.)

17825

ISOLATION OF RADIOGENIC CALCIUM FROM MICA FOR ISOTOPIC ANALYSIS. V. I. Baranov and Yu-wei Ch'ên (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim. 15, 163-5(1960) Mar.-Apr. (In Russian)

A method for isolating radiogenic calcium from micas (lepidolite and muscovite) is presented. The samples are decomposed with pyrophosphoric acid. Isolation and purification from potassium are carried out by the chromatographic method on the cationite. The yield of calcium is more than 90%. The above method is used when the age of micas is determined by the calcium method. (auth)

17826

ISOLATION OF RARE EARTHS FROM MINERALS. F. V. Zaikovskiĭ and V. S. Bashmakova. Zhur. Anal. Khim. 15, 166-9(1960) Mar.-Apr. (In Russian)

It is shown that cerium and yttrium rare earth oxalates, when crystallized with calcium oxalate, can be isolated only by double precipitation. Sodium p-aminosalicylate is suggested for the separation of thorium from rare earths. A method for isolating rare earths from minerals is developed. (auth)

17827

RAPID METHODS FOR SPECTROGRAPHIC ANALYSIS OF RARE ELEMENTS. COMMUNICATION 1. ANALYSIS OF COMPLEX MIXTURES OF RARE EARTHS. V. A. Korneev. Zhur. Anal. Khim. 15, 170-4(1960) Mar.-Apr. (In Russian)

A rapid method for complete analysis of complex mixtures of rare earths is based on the use of the homologous pairs in combination with the stage weakening of the spectrum. The method permits determination of all the individual rare earths in the range of concentrations (0.1 to 2) to 100%, with an accuracy of ±10 to 20% (relative). The method is 8 to 10 times more rapid than the other spectrographic methods. (auth)

17828

PHOTOMETRIC DETERMINATION OF THORIUM IN MONAZITES WITH THE ARSENAZO II REAGENT. V. I. Kuznetsov and S. B. Savvin (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim. 15, 175-9(1960) Mar.-Apr. (In Russian)

A method is described for the photometric determination of thorium in monazites with the arsenazo II reagent directly after the decomposition of monazite without separating thorium from the impurities. No interference is caused by phosphates (up to 30% P_2O_5), Zr, Ti, Mo, V, W

(up to 0.2 to 0.5%), rare earths, and other elements. The time for a determination is 25 to 30 min. The relative error is not more than 3 to 5%. (auth)

17829

ANALYTICAL CHEMISTRY OF URANIUM. COMMUNICATION 1. ON THE LUMINESCENT DETERMINATION OF URANIUM. V. F. Grigor'ev, V. F. Luk'yanov, and E. P. Duderova. Zhur. Anal. Khim. 15, 184-90(1960) Mar.-Apr. (In Russian)

An electric furnace with a platinum case is proposed for preparing luminescent samples with high accuracy. The mean reproducibility of the luminescence of the disks made of a fluoro-carbonate mixture and a pure solution of the uranyl salt is ±2%. A tube with a piston is proposed for proportioning the flux powder. The mean accuracy of proportioning is ±1.5%. An apparatus is proposed for granulating the flux. Granules are uniform in their composition and have high breaking strength. The weight of the granules is 110 mg. The reproducibility of the weight is ±1%. An improved rapid modification of the method of preparing beads is suggested. The mean reproducibility of the luminescence of the beads made of sodium fluoride and a pure solution of the uranyl salt is 6 to 7%. The design of a photoelectric instrument for measuring the intensity of the luminescence of disks, beads, and powders is developed. The deviation of the pointer in the range of maximum sensitivity by the whole scale of 150 mm corresponds to the concentration of uranium in the disk being equal 0.08 γ/g. The readings of a sample with the uniformly distributed uranium are reproducible within the limits ±1.5%. Methods for determining uranium without the preliminary purification were tested on the standard ores. (auth)

17830

MOLYBDENOMETRY. COMMUNICATION 2. THE TITRATION OF SEXAVALENT MOLYBDENUM BY MEANS OF TRIVALENT MOLYBDENUM SOLUTION. A. I. Busev and Li Gyn (Lomonosov Moscow State Univ.). Zhur. Anal. Khim. 15, 191-9(1960) Mar.-Apr. (In Russian)

The reduction of sexavalent molybdenum by means of a trivalent molybdenum solution was studied. In definite conditions the reaction proceeds stoichiometrically in accordance with the equation: $2\,MoO_4^{2-} + Mo^{III} + 16H^+ = 3Mo^V + 8H_2O$. The behavior of a number of elements in the conditions of the molybdenum titration was studied. (auth)

17831

DETERMINATION OF PALLADIUM WITH β-HYDROXY-α-NAPHTHALDEHYDE. A. S. Pesis and Z. A. Bitovt (Perm Medical Inst., USSR). Zhur. Anal. Khim. 15, 200-2(1960) Mar.-Apr. (In Russian)

A gravimetric method is suggested for the determination of palladium with β-hydroxy-α-naphthaldehyde in a nitric acid medium (pH 2.5 to 3). The precipitation is carried out without heating. As β-hydroxy-α-naphthaldehyde reacts with some cations at different pH, it is possible to determine palladium without separating it from copper, cobalt, nickel, and lead at the ratios 1:100, iron at 1:15, silver at 1:20, platinum at 1:2. (auth)

17832

A METHOD FOR THE DETERMINATION OF THE ABSOLUTE QUANTITIES OF IONIUM ($_{90}Th^{230}$). K. B. Zaborenko and N. V. Filippova (Lomonosov Moscow State Univ.). Zhur. Anal. Khim. 15, 203-6(1960) Mar.-Apr. (In Russian)

A proposed method enables ionium to be obtained in a state of radiochemical purity and its electrolytic isolation on the cathode, suitable for α-counting. The electrolyte contains: impulse quantities of thorium isotopes, 10 to 100 mg of cerium salt, about 1 g of $(NH_4)_2SO_4$ at pH 3.4, and 1/3 by volume of ethyl alcohol. The temperature of the electrolyte is 70°, the cathode current density is 200 ma/cm^2, the time of the electrolysis is 30 min. The absolute quantity of ionium is calculated directly out of the results of the α-activity measurement taking into consideration all corrections, or indirectly by comparing with standard ionium preparations. The method was tested on the natural samples. (auth)

17833

DETERMINATION OF FREE BORON IN BORON CARBIDE, BORON NITRIDE AND ALLOYS ON THEIR BASIS. E. E. Kotlyar and T. N. Nazarchuk (Inst. of Metalloceramics and Special Alloys, Kiev). Zhur. Anal. Khim. 15, 207-10(1960) Mar.-Apr. (In Russian)

A method is developed for determining free boron in boron carbide and boron nitride. The method is based on free boron oxidation with a perhydrol and nitric acid, while boron, combined in carbide or nitride, is not oxidized. The determination of free boron ends in the titration with alkali in the presence of invert sugar. (auth)

17834

ON THE DETERMINATION OF TRITIUM. G. N. Trusov and N. A. Aladzhalova. Zhur. Anal. Khim. 15, 238-9(1960) Mar.-Apr. (In Russian)

A method is worked out for the analysis of water for the tritium concentration without converting water into gas. The analysis is carried out with the use of the internal-filling counter. (auth)

17835

SEPARATION OF TITANIUM FROM TUNGSTEN BY ION-EXCHANGE CHROMATOGRAPHY. D. I. Ryabchikov and V. E. Bukhtiarov (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim. 15, 242(1960) Mar.-Apr. (In Russian)

Titanium and tungsten are transformed into complex ions with opposite charges in an ammonia medium (pH-5) in the presence of hydrogen peroxide. When the solution containing a pair of these metals is passed through the cationite, titanium is absorbed with the active groups of the resin, whereas tungsten goes completely into the filtrate. (auth)

17836

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

DETERMINACIÓN DE BAJAS CONCENTRACIONES DE D_2O EN AGUA POR EL MÉTODO DEL FLOTADOR. Informe No. 27. (Determination of Low Concentrations of D_2O in Water by the Flotation Method. Report No. 27). Lucía Cannavale. 1960. 7p.

A method is described for the determination of the D_2O concentration in water. It is based on the relationship which exists between density and temperature which permits a determination of the density calculated from the measurement of the temperature. The temperature at which normal water has the same density as a Pyrex floater is compared with the temperature at which the floater has the same density as the unknown sample. (J.S.R.)

General Inorganic and Physical Chemistry

17837 ANL-6171

Argonne National Lab., Ill.

KINETICS OF PARTICLE GROWTH IN A FLUIDIZED CALCINER. Bernard S. Lee. June 1960. 138p. Contract W-31-109-eng-38. OTS.

Based on a thesis submitted to Polytechnic Inst. of Brooklyn.

Fluidized calcination involves the injection of an atomized feed solution containing dissolved solids into a bed of fluidized particles at elevated temperatures suitable for drying and calcining. The study was conducted in a three-inch diameter fluidized column using aluminum oxide as bed material and aqueous aluminum nitrate solution as feed. Products were removed at regular intervals to maintain a constant bed weight. Particle growth was traced by adding radioactive aluminum oxide seeds of a given size to the starting bed and following their progress as they grew into successively larger sieve fractions. The effects on the growth rate of operating variables and physical properties of the feed were studied, including fluidizing air velocity, atomizing air rate, column temperature, feed concentration, feed rate, and viscosity and surface tension of the feed. For each product using screen analysis and gamma-counting data a volume-surface mean diameter of the seed-containing particles was calculated. Upon statistical analysis a linear relationship between the mean diameter of seed-containing particles and time exhibited very strong correlation, substantiating the hypothesis that particle growth was proportional to its surface area. From this linear relationship the over-all growth constant, equal to the slope, was obtained. Attrition effect of the atomizing air was found statistically to be non-significant. Normal growth far outweighed attrition and for steady-state operation other methods to produce seeds, such as jet or target attrition must be employed to balance normal growth. (auth)

17838 CF-60-5-112

Oak Ridge National Lab., Tenn.

THE OXIDATION OF CHROMIUM(III) TO CHROMIUM(VI) IN THE PRESENCE OF PLATINUM METALS. N. E. Wisdom, R. S. Greeley, and J. C. Griess. May 23, 1960. 5p. OTS.

Ruthenium, either as soluble salts, powdered metal, or oxide, catalyzed the oxidation of Cr(III) to Cr(VI) in dilute oxygenated sulfuric acid solutions. Under the same conditions, in the absence of ruthenium, Cr(VI) was not produced. In a 2 M $Al(NO_3)_3$–1 M HNO_3 solution at atmospheric boiling point, ruthenium and compounds of ruthenium, platinum, palladium, rhodium, and osmium very markedly increased the rate at which Cr(III) was oxidized to Cr(VI). Very low concentrations of ruthenium were capable of causing the oxidation to proceed at an appreciable rate. In boiling 65% nitric acid, Cr(III) was oxidized to Cr(VI) if reduced oxides of nitrogen were removed from solution either in the presence or absence of ruthenium; without removal of the oxides of nitrogen, detectable quantities of Cr(VI) were not formed in either case. Cr(VI) was not produced in boiling and aerated uranyl sulfate solutions containing ruthenium. (auth)

17839 GA-1355

General Dynamics Corp. Electric Boat Div., Groton, Conn.

THERMODYNAMIC AND TRANSPORT PROPERTIES OF HELIUM. M. P. Wilson, Jr. Jan. 1960. 145p. Contract AT(04-3)-187. (MGCR-PR-60-1550). OTS.

The thermodynamic and transport properties of helium at 0 to 1600°F and in the pressure range of atmospheric to 8000 psia are presented. Calculated properties are correlated with experimental data. (C.J.G.)

17840 HW-61048

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

AN AQUA REGIA FLOWSHEET FOR URANIUM DISSOLUTION. J. J. Shefcik. July 21, 1959. 6p. Contract AT(45-1)-1350. OTS.

A dilute aqua regia flowsheet for the complete dissolution of solid uranium slugs in 7.5 hours is shown. Before the dissolver product solution can be further processed in stainless steel equipment, the chloride must be removed. Two flowsheets for chloride removal are presented. In the first flowsheet, the chloride is removed by volatilization and in the second, by oxidation. The chloride removal need not be carried out in the dissolver vessel. The larger safe batch sizes of a homogeneous system may permit combining several batches from the heterogeneous dissolver system before chloride removal. Titanium, Haynes 25, and Hastelloy F are possible materials of construction for the process equipment that is to contain both nitric and hydrochloric acids. (auth)

17841 HW-63534

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

OXYGEN REMOVAL WITH HYDRAZINE. Interim Report. Thomas F. Demmitt. Jan. 25, 1960. 9p. Contract AT(45-1)-1350. OTS.

Data obtained during preliminary studies of hydrazine-dissolved oxygen systems are presented. In general the amount of oxygen removed increased as the reaction time, solution temperature, and initial hydrazine-to-oxygen ratio increased. At the most favorable conditions, however, only about 25% of the initial oxygen concentration was removed. Further investigation is recommended. (J.R.D.)

17842 HW-63917

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRELIMINARY REPORT ON THE USE OF ACTIVATED CARBON AS A CATALYST FOR THE DISSOLVED OXYGEN–AQUEOUS HYDRAZINE REACTION. Thomas F. Demmitt. Feb. 24, 1960. 8p. Contract AT(45-1)-1350. OTS.

The feasibility of using a bed of activated carbon to catalyze dissolved oxygen–aqueous hydrazine reaction was investigated. Results indicate that activated carbon is effective at 100 gallons/min per foot of bed at 39 to 62°F. (J.R.D.)

17843 ORNL-2938

Oak Ridge National Lab., Tenn.

PURIFICATION OF BERYLLIUM COMPOUNDS: A LITERATURE SURVEY. R. E. Moore. June 16, 1960. 44p. Contract W-7405-eng-26. OTS.

Industrial production of technical and nuclear grade beryllia, laboratory-scale preparations of purer oxide, and separate purification processes are discussed. Several American and a French process for making nuclear-grade beryllia (300 to 500 ppm impurities) are described. In the U.S.S.R. oxide with only 50 to 110 ppm impurities is made from commercially distilled basic acetate, and metal with 200 ppm impurities is produced by commercial distillation. Beryllia which is purer than that commercially available was made by laboratory-scale extraction and distillation of acetate, recrystallization of oxalate, and extraction of the perfluorobutyrate. Precipitations and crystallizations from solution and ion exchange may be useful preliminary steps in procedures aimed at preparing ultrapure beryllia. Liquid-liquid extraction and vacuum sublimation meet the requirements for final processes because of their theoretical capabilities and because closed systems using plastic equipment may be used to minimize contamination. Extraction methods discussed involve or-

ganic extractions of aqueous solutions of the basic acetate, acetylacetonate, and organic salts. (auth)

17844 TID-6059

Purdue Univ., Lafayette, Ind.

ABSORPTION SPECTROSCOPY IN LIQUID ANHYDROUS HYDROGEN FLUORIDE. Angelo Tulumello. [1960?]. 10p. OTS.

A literature survey was made in conjunction with the study of transition metal complexes in liquid anhydrous hydrogen fluoride. Consideration is given to the effect of the solvent as a coördinating agent, coördinating properties of ligands, and the ability of the metal to form complexes. This review considers primarily the infrared, visible, and ultraviolet spectra. 25 references. (B.O.G.)

17845 TID-6062

Michigan. Univ., Ann Arbor.

MERCURY-PHOTOSENSITIZED REACTIONS INVOLVING NITRIC OXIDE, NITROUS OXIDE, AND HYDROGEN. Morton Z. Hoffman and Richard B. Bernstein. June 1960. 42p. Contract AT(11-1)-321. OTS.

The N^{14}/N^{15} and O^{16}/O^{18} isotope effects in the $Hg(6^3P_1)$-photosensitized decomposition of nitrous oxide were measured. Observed isotopic fractionation factors, S^0 (interpreted in terms of ratios of rate constants for quenching by $N^{14}N^{14}O^{16}$ vs. $N^{15}N^{14}O^{16}$, $N^{14}N^{15}O^{16}$, and $N^{14}N^{14}O^{18}$), are related to the ratio of isotopic quenching cross sections by the relation $Q/Q^* = S^0-(\mu/\mu^*)^{1/2}$, where μ and μ^* are the collisional reduced masses for Hg and the light and heavy isotopic molecules, respectively. The quenching cross section ratio for $N^{14}{}_2O^{16}/N^{14}{}_2O^{18}$ was unity within the experimental uncertainty (± 0.1%). The ratios for $N^{14}N^{14}O^{16}/N^{15}N^{14}O^{16}$ and $N^{14}N^{14}O^{16}/N^{14}N^{15}O^{16}$ differed from unity by +0.98% and +0.44%, respectively. The order of the quenching cross sections for the isotopic nitrous oxide molecules is thus: $N^{15}N^{14}O^{16} < N^{14}N^{15}O^{16} < N^{14}N^{14}O^{18} \cong N^{14}N^{14}O^{16}$. The implications of the present observations are briefly discussed. (auth)

17846 TID-6079

Massachusetts Inst. of Tech., Oak Ridge, Tenn. Engineering Practice School.

ANALYSIS OF EXPERIMENTAL DATA ON THE HOLDUP OF RADIOACTIVE GASES ON CHARCOAL ADSORPTION TRAPS. T. J. Delaney, L. M. Davis, and M. J. Friedman. Mar. 3, 1959. 27p. For Oak Ridge Gaseous Diffusion Plant. (KT-389). OTS.

An IBM-704 computer program was developed to correlate data on the adsorption of radioactive off-gases on charcoal. To perfect the design of charcoal beds, a series of experiments were run to determine the holdup time of krypton and xenon as a function of temperature, flow rate, and bed geometry. A carrier gas was fed continuously through a charcoal trap, a measured quantity of radioactive gas was injected instantaneously into the feed stream, and the activity of the gas leaving the trap was measured as a function of time. The experimental data were fitted with a curve and the output of the program consisted of final valves of constants, deviations between calculated and experimental curves, and cathode-ray-tube plots of these curves. In most cases, the program fitted the experimental curves very closely. (M.C.G.)

17847 TID-6100

Horizons, Inc., Cleveland.

A REVIEW OF THE EXTRACTIVE METALLURGY OF NIOBIUM. M. E. Sibert, A. J. Kolk, Jr., and M. A. Steinberg. [1957?]. 58p. Contract AT(30-1)-1894. OTS.

The preparation of niobium was attempted by a number of chemical and electrochemical routes. Chemical reduction of oxides and halides such as Nb_2O_5, K_2NbOF_5, K_2NbF_7, and $NbCl_5$ was conducted with varying degrees of success. Aqueous electrochemical reduction has not yet yielded a metallic deposit. The electrolysis of molten baths containing K_2NbOF_5 or K_2NbF_7 produced niobium metal. The more promising methods of preparation for Nb metal at the present time include the reaction of Nb_2O_5 with C, the H_2 and active metal reduction of $NbCl_5$, and electrolysis of K_2NbF_7–NaCl melts. (auth)

17848 UCRL-9193

California. Univ., Berkeley. Lawrence Radiation Lab.

LONGITUDINAL DISPERSION IN BEDS OF FINELY DIVIDED SOLIDS (thesis). Jerry Max Robinson. June 1960. 55p. Contract W-7405-eng-48. OTS.

Experimental determinations of the longitudinal dispersion coefficient and the Peclet number were made for three binary gas systems. The experimental technique involved measuring the dispersion of a step function input to a column packed with glass beads. The diffusional model was employed to obtain the differential equation describing longitudinal dispersion in a packed column. This equation was solved with suitable boundary conditions, and the solution was used in the analysis of the experimental dispersion data. The experimental results show a variation in the Peclet number from 0.1 to 0.6, and in the eddy dispersion coefficient from 0.03 to 1.0 cm^2/sec for the Reynolds number range from 0.03 to 1.0. (auth)

17849 AEC-tr-4118

URANIUM DIOXIDE ANODES IN MOLTEN CHLORIDE ELECTROLYTE. M. V. Smirnov and L. E. Ivanovskii (Ivanovski). Translated from Zhur. Obshchei Khim. 27, 295-9(1957). 6p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 7158.

17850

THE PURIFICATION OF INERT GASES BY HOT URANIUM. PART I. P. C. Davidge (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.) and N. Hodge and G. N. Stockdale (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Brit. Chem. Eng. 5, 477-83(1960) July.

The purification of inert gases by hot uranium was investigated for the impurities CO, CO_2, O_2, and H_2O in argon in the temperature range 0 to 1000°C. The removal of CO from argon by a Ti-Zr alloy was also studied for comparison. Uranium was in the form of cleaned and degassed turnings supported on alumina or platinum in a bed. The product from passing Ar-CO through the bed was found to consist of ~60% UO_2, 35% UN, some UC, and the unchanged metal; and uranium was found to be effective in removing CO from Ar above 600°C. For the other impurities, the efficiency temperature was slightly lower, and the proportion of the nitride produced from U + CO_2 was lower, while the main product from U + O_2 was U_3O_8. The effects of some of the variables, e.g., bed pressure drop and temperature, on the purification efficiency were also studied. (D.L.C.)

17851

THE NIOBATE AND TANTALATE OF ZIRCONIUM. V. I. Spitsyn, L. N. Komissarova, Z. A. Vladimirova, Yu. P. Simanov, and N. N. Tyutyueva (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 857-60(1960) Apr. 1. (In Russian)

The synthesis of zirconium niobates and tantalates was studied. Mixtures of zirconium hydroxides and niobium

were prepared with ratios of ZrO_2 : Nb_2O_5 of 2 : 1, 1 : 1, and 1 : 2 and zirconium hydroxides and tantalum with a ZrO_2 : Ta_2O_5 ratio of 2 : 1. The synthesis of $ZrO_2 \cdot Nb_2O_5$ is reached at 1000°C after 6 hours, while $ZrO_2 \cdot Ta_2O_5$ develops after 40 hours at 1300°C. The niobates and tantalates are white fine-crystal compounds with large numbers of x-ray-diffraction lines, large slip angles, and densities of 5.70 for $(ZrO)_2Nb_2O_7$ and 7.82 for $(ZrO)_2Ta_2O_7$. The melting points of zirconium niobate and tantalate are 1700 ± 20°C and 1730 ± 20°C, respectively. At 20 to 1400°C the preparations show no phase variations. The reaction of zirconyl niobates and tantalates with CCl_4 is about 3 to 4 times slower than corresponding oxide mixtures. The resistance of zirconyl tantalate is stronger to chlorinating agents than zirconyl niobate and at 500°C it does not chlorinate. The effects of various reagents [HCl (36%), H_2F (25%), H_2SO_4 (94%), and NaOH (40%)] on zirconyl niobate and zirconyl tantalate were tested. (R.V.J.)

17852

ON THE PRODUCTION OF URANIUM CARBIDES. II. REACTION BETWEEN URANIUM POWDER AND SOME HYDROCARBONS. Tadao Sano, Shōsuke Imoto and Yoshihiko Takada (Osaka Univ.). J. Atomic Energy Soc. Japan 2, 285-90(1960) May. (In English)

The reactions between uranium powder produced by hydrogenation and some hydrocarbons for the preparation of uranium monocarbide were studied. Propane and butane were found to have greater reactivity than methane and ethylene, which can be explained by assuming that free radicals produced by the decomposition of hydrocarbons should be involved in the reaction. Free radicals are so reactive that the formation of uranium carbides can occur at much lower temperatures than through the reactions between carbon and uranium or carbon and uranium oxides. For example, uranium monocarbide can be formed at room temperature through the reaction between uranium powder and propane gas, under irradiation with γ rays from Co^{60}. Uranium dicarbide, on the other hand, was produced through the same reaction at about 800°C. (auth)

17853

EXPERIMENTAL STUDY OF THE ADSORPTION OF FISSION PRODUCTS ON ACTIVATED CARBON. E. Spode and E. Weber (Deutsche Akademie der Wissenschaften, Berlin-Buch). Kernenergie 1, 165-7(1958) Mar. (In German)

A study was made of the adsorption of fission products in solution on activated carbon as affected by pH. Chloride solutions of Y^{91}, Ce^{144}-Pr^{144}, and Cs^{137} were buffered at various pH levels and activated carbon put in. The use of buffers also made it possible to study foreign-ion effects. The results are tabulated and discussed as to the usefulness of this process in treating waste water. (T.R.H.)

17854

THE LIMITING LOW-TEMPERATURE BEHAVIOR OF THE HEAT CAPACITY OF GRAPHITE. P. Flubacher, A. J. Leadbetter, and J. A. Morrison (National Research Council, Ottawa). Phys. and Chem. Solids 13, 160-3(1960) May. (In English)

Previous interpretions of the low-temperature heat capacity (C) of graphite are criticized and shown to contain inconsistencies. The equation for C is best put into the form $C = aT^3 + bT^2 + \gamma T$, and analysis of the data plotted on a C/T^2 vs. T graph gives $a = 6.27 \pm 0.06 \times 10^{-6}$. The b term represents the effect of particle size on C and varies with the grade of the graphite used. The γ term represents the electronic effect. The data are consistent with the value 0.3×10^{-5} predicted by theory. (D.L.C.)

17855

ABSORPTION SPECTRUM AND ZEEMAN EFFECT OF CRYSTALLINE DYSPROSIUM SALTS AT LOW TEMPERATURES. G. Gramberg (Technische Hochschule, Darmstadt, Ger.). Z. Physik 159, 125-48(1960). (In German)

The absorption spectrum of the Dy^{3+} ions between 18000 and 27000 cm^{-1} was investigated in $Dy(C_2H_5SO_4)_3 \cdot 9H_2O$, $DyCl_3 \cdot 6H_2O$, and $DyNO_3 \cdot 6H_2O$. The Zeeman effect was also studied in the ethyl sulfate and chloride at 4.2 and 58°K. In evaluation of the Zeeman effect allowance was made for the difference in the effects of external and local magnetic fields, and the local magnetic field was calculated. Interpretations were developed on the basis of experimentally determined J-values and g-factors for three of the absorption groups found. From the ground state splittings, the magnetic susceptibility and the magnetic specific heat were calculated for low temperatures. The calculated data were in good agreement with direct measurements. (M.C.G.)

17856

MEASUREMENT OF THE SATURATED VAPOR PRESSURE OF BORIC ANHYDRIDE. An. N. Nesmeyanov and L. P. Firsova. Zhur. Fiz. Khim. 34, 1032-5(1960) May. (In Russian)

The vapor pressure of boric anhydride was measured at 1299 to 1515°K by the effusion method. An equation is presented, expressing its dependence upon 1/T. In the above temperature range dissociation is shown to be negligibly small. The heat of vaporization of boric anhydride was calculated from the experimental results and from data taken from the literature. (auth)

17857

ON THE MECHANISM OF THICKENING. A. M. Gaudin and M. C. Fuerstenau (Massachusetts Inst. of Tech., Cambridge). Group II: Paper No. 6. Preprint. London, Institution of Mining and Metallurgy, 1960. 13p.

Results of an experimental and theoretical study of pulp thickening are given. Measurements of pulp density as a function of time and position are presented and interpreted, while a mathematical model is also described and discussed. It is suggested that the settling of thick flocculated pulps is a bimodal process equivalent to filtration through both tubes and tubules. Filtration through tubes takes place and is completed at an earlier stage, while that through tubules continues indefinitely within the experimental range. Where the pulps are initially thin the two stages described above must be preceded by free and hindered settling of flocs. (auth)

Radiation Chemistry and Radiochemistry

17858 AD-231270

Quantum, Inc., Wallingford, Conn.

THE FORMATION OF NEW POLYMERS USING IONIZING RADIATION. Final Report [for] September 12, 1958—September 12, 1959. R. F. Horan. 53p. Contract DA-44-009-ENG-3723.

Gamma radiation as a tool for the synthesis of polymeric structural plastics for use at elevated temperatures was examined. Experiments are reported from which polymer products resulted from exposure to the ionizing gamma radiation from a Cobalt 60 source. Some of the polymer products have a melting or decomposition temperature greater than 300°C. The class of polymers represented by the type compounds triallylcyanurate-phosphonitrillic

chloride and triallylcyanurate-vinyl stannanes showed the most outstanding promise. However, at this laboratory no extensive physical or chemical analyses were performed on the irradiation products. (auth)

17859 MLM-613(Del.1)
Mound Lab., Miamisburg, Ohio
REPORT FOR RESEARCH ON SUBSTITUTE MATERIALS [FOR] APRIL 2, 1951 TO JULY 2, 1951. (ACTINIUM-227). Aug. 6, 1951. Decl. May 3, 1960. 71p. Contract AT(33-1)-GEN-53. OTS.

development work on the process for recovery of Ac^{227} from neutron-irradiated Ra is described. Due to unavailability of Ac, La is used as a stand-in in the experiments. The problems currently being investigated are preparation of La, vaporization of La and Ac at about 2,000°C, adsorption of Rn released during the processing of Ra, and purification of Ac^{227}. (T.R.H.)

17860 AEC-tr-3895
MAIN TECHNOLOGICAL CHARACTERISTICS OF APPARATUS FOR RADIOCHEMICAL PROCESSES (IN PARTICULAR IN THE POLYMERIZATION OF ETHYLENE) ON AN INDUSTRIAL SCALE. (Osnovnye Tekhnologicheskie Kharakteristiki Apparatov dlya Provedeniya Radiatsionno-Khimicheskikh Protsessov (v Chastnosti, dlya Polimerizatsii Etilena) v Promyshlennom Masshtabe). N. P. Syrkus, A. Kh. Breger, and B. I. Valʹnshteĭn. Translated from a paper presented at the International Conference on High Energy Sources of Radiation, Warsaw, September 8-12, 1959. 20p. OTS.

Technological characteristics of radiochemical apparatus in cylindrical and spherical shapes were considered. A method is given for evaluating the effectiveness of the design. Specific calculations were made for an apparatus designed for radiation polymerization of ethylene at 200 atm. and 25°C, with a γ source of varying activity. It is shown that the calculations can be made on the basis of the average value of the dosage rates. The proposed method can be applied, after specific considerations, to other radiochemical processes. It is shown that the output, with all other conditions being equal, is an exponential function of the power of the γ source. (B.O.G.)

17861 AEC-tr-4083
STUDY OF SOME CHEMICAL REACTIONS PRODUCED BY β AND γ RAYS OF RADIUM ON SUBSTANCES IN THE VAPOR PHASE. Jacques Errera and Victor Henri. Translated from J. phys. radium (6) 7, 225-9(1926). 9p. JCL.

It is suggested that the action of radium β and γ rays on chlorobenzene produces a polymerization of the molecule. When the same radiation acted on a mixture of chlorobenzene and hydrogen, the aromatic nucleus was hydrogenated and no benzene was formed. In a mixture of benzene and air or oxygen, phenol was formed by the radiation. The number of phenol molecules formed was at least 60 times greater than the number of ions produced by the rays. Neither the position, intensity, nor the fine structure of the absorption bands of benzene, chlorobenzene, or phenol vapor underwent any modification under the action of β and γ rays. An electric field of 10,000 v/cm or a magnetic field of 20,000 gauss had no effect on the absorption spectrum of benzene, phosgene, or sulfur dioxide. (auth)

17862 AEC-tr-4112
ON CERTAIN REACTION MECHANISMS OF HOT ATOMS. Ian Campbell. Translated from Nukleonika 2, 605-15(1957). 12p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 6505.

17863 NP-tr-455
THE CHEMICAL BEHAVIOUR OF Mo^{99} FORMED DURING THE IRRADIATION OF URANIUM OXIDES WITH SLOW NEUTRONS. L. V. Shiryaeva and Yu. M. Tolmachev. Translated from Atomnaya Energ. 6, 528-32(1959). 7p. JCL or LC.

The separation of Mo^{99} from irradiated U_3O_8 and UO_2 specimens, annealed in a vacuum or in a stream of argon at 400 to 1200°C, was investigated. Relationships are shown to exist between the percentage extraction of Mo^{99} and the annealing temperature and annealing time. The activation energy for the removal of Mo^{99} from the uranium oxide grains was calculated. (auth)

17864
A NEW APPROACH TO RADIOASSAY OF AQUEOUS SOLUTIONS IN THE LIQUID SCINTILLATION SPECTROMETER. Daniel Steinberg (National Heart Inst., Bethesda, Md.). Anal. Biochem. 1, 23-39(1960) June.

A new two-phase counting method is described that permits radioassay of aqueous solutions in the liquid scintillation spectrometer. The sample in solution is pipetted onto crystals of anthracene in a standard counting bottle, and the fluorescent emission is counted. The general features of the technique are discussed from a theoretical and practical point of view. Efficiencies as high as 54% for small volumes of C^{14} samples can be obtained. In the routine procedure described the C^{14} in 3 ml of sample is counted with approximately 20% efficiency. Efficiencies for H^3, Ca^{45}, P^{32}, and I^{131} are presented. The efficiencies for C^{14} obtained with several other solid fluors, including a plastic scintillator, are presented. The advantages of the method over existing methods are several. It is general and applicable to virtually any compound soluble in water, salt solutions, dilute acid, or dilute alkali; no chemical conversion or other preliminary handling is necessary, and sample preparation is simple and rapid; samples can be recovered unaltered after radioassay and used for further characterization; and large quantities of sample can be counted, limited only by their solubility in the liquid phase, and, in the case of colored compounds, by quenching effects. (auth)

17865
HOT-ATOM CHEMISTRY OF HALOGENS IN COBALT-AMMINE COMPLEX SALTS. I. HOT-ATOM CHEMISTRY OF BROMINE IN BROMOPENTAMMINE COBALT COMPLEX SALTS. Nobufusa Saito, Hirotoshi Sano, and Takeshi Tominaga (Tokyo Univ.). Bull. Chem. Soc. Japan 33, 20-4(1960) Jan. (In English)

Thermal neutron irradiation of $[Co(NH_3)_5Br]^{2+}$ salts, producing Br^{80m} and Br^{82}, was studied with the salts in solid and aqueous solution phases and as absorbed on a cation exchange resin, which was subsequently used as a means of separation. The fraction of radiobromine retained as ligand was determined by adding the sample to the resin and eluting the anionic bromine, then removing the ligand bromine by digesting at higher temperatures. The fraction of freed radiobromine in all cases exceeded 80%, and the order of increasing free fraction in the phases was solid, resin, solution. In the case of the salts absorbed on the resin, a considerable fraction of radiobromine was retained on the resin, which no amount of severe treatment could remove; this radiobromine is presumed to be organically combined with the resin. (D.L.C.)

17866
BEHAVIOR OF ENERGETIC RADIOBROMINE ATOMS ARISING FROM (n,γ) REACTION IN COBALT COMPLEX

SALTS. Nobufusa Saito, Takeshi Tominaga, and Hirotoshi Sano (Tokyo Univ.). Bull. Chem. Soc. Japan 33, 120-2(1960) Jan. (In English)

Radiobromine (Br^{80m} and Br^{82}) produced by neutron irradiation of $[Co(NH_3)_5Y]Br_x$ and $[Co(en)_2Y_2]Br_y$ was found to enter the ligand spheres of these complexes. In order to understand the mechanism of such entrances, the effects of Y (Br^-, Cl^-, en, F^-, H_2O, I^-, NCS^-, NH_3, NO_2^-, and NO_3^-) on this "ligand yield" were investigated. A model was devised in which collisions of hot bromine atoms with the donor atom in Y plays an important role, and a theoretical curve of ligand yield vs. a function of the masses of these atoms is derived. With a few exceptions, the ligand yield experimental data fall on or near this curve, and it is concluded that kinetic processes play an important role in determining the fate of hot bromine atoms in such complex salts. (D.L.C.)

17867

THE RADIOLYSIS OF CYCLOHEXANE. II. CYCLOHEXANE-CYCLOHEXENE SOLUTIONS AND PURE CYCLOHEXENE. G. R. Freeman (Univ. of Alberta, Edmonton, Can.). Can. J. Chem. 38, 1043-52(1960) July.

The γ-radiolysis of cyclohexane–cyclohexene solutions and of pure cyclohexene was investigated. The previously determined yields of the two activated species in irradiated cyclohexane were confirmed. $G(c\text{-}C_6H_{12}'') = 3.0 \pm 0.3$ and $G(c\text{-}C_6H_{12}') = 2.4 \mp 0.3$. The yields of the main products of cyclohexene radiolysis are $G(H_2) = 1.2$, $G(c\text{-}C_6H_{12}) = 1.0$, $G[(c\text{-}C_6H_9)_2] = 1.4$, and $G(c\text{-}C_6H_{10} \rightarrow \text{higher polymer}) \approx 4$. There were smaller amounts of ethylene, acetylene, a C_4 hydrocarbon (probably butadiene), cyclohexylcyclohexene, and dicyclohexyl. For the reactions $2c\text{-}C_6H_9 \rightarrow (c\text{-}C_6H_9)_2$ (1), $c\text{-}C_6H_9 + c\text{-}C_6H_{11} \rightarrow c\text{-}C_6H_9 - C_6H_{11}$ (2), and $2c\text{-}C_6H_{11} \rightarrow (c\text{-}C_6H_{11})_2$ (3), the value $k_2/(k_3k_1)^{1/2} = 0.45 \pm 0.08$ was determined. The reaction mechanism that occurs during the radiolysis of cyclohexane–cyclohexene solutions is similar to that which occurs during the radiolysis of cyclohexane–benzene solutions (Part I of this series) with the additional observation that cyclohexene itself is considerably decomposed during the radiolysis. (auth)

17868

EFFECT OF NITRIC OXIDE IN THE γ-RADIOLYSIS OF ETHANE AT VERY LOW CONVERSIONS. Kang Yang (Continental Oil Co., Ponca City, Okla.). Can. J. Chem. 38, 1234-5(1960) July.

The formation of H_2 was investigated in the γ radiolysis of ethane with and without NO as a scavenger. The results, plotted on a % H_2 vs. time graph, show that in the absence of NO the rate decreases with increasing conversion, the initial rate being 1.93 times the rate at 0.68% conversion, in agreement with Back and Miller. In the presence of NO, on the other hand, the rate is constant, and the percentage of radical contribution to the H_2 formation is estimated to be 64%, in close agreement with the value of 63% obtained by Back using ethylene as scavenger. It is concluded that NO and ethylene scavenges H atoms with negligible effect on the nonradical processes leading to molecular H_2. (D.L.C.)

17869

RADIATION METHOD FOR THE PRODUCTION OF SOME PHOSPHONITRYLCHLORIDE DERIVATIVES. V. I. Spitsyn, N. A. Afanas'eva, A. K. Pikaev, I. D. Kolli, and P. Ya. Glazunov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1106-8 (1960) Apr. 11. (In Russian)

The synthesis of butyl phosphonitrile ether by high-energy electron irradiation of tetrameric phosphonitrile chloride and n-butyl alcohol was investigated at room temperature. 80 ml of 5% tetrameric phosphonitrile chloride in abs. n-butyl alcohol were irradiated for 6 hours by 0.06 Mev electrons at 3 μa. The integral dose was 1.5×10^{22} ev/ml. After irradiation the n-butyl alcohol was distilled in a vacuum; product yield was 45%. The viscosity of the irradiated solution was determined, and characteristic viscosity variations are plotted as functions of dose. The high yield, simplicity of extraction, and low temperature of the reaction proved the radiation method of butyl phosphonitrile ether production more advantageous than other methods. (R.V.J.)

17870

CALCULATION OF THE YIELDS OF ALKANE RADIOLYSIS PRODUCTS. Yu. A. Kolbanovskiĭ and B. A. Smirnov (Inst. of Technological Chemical Synthesis of Oil, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1380-2(1960) Apr. 21. (In Russian)

Experiments were undertaken for deriving equations which express alkane radiolysis yield balance and for determining the composition of various fractions. Calculations were made of the yields of heavy residue (which does not render itself easily to experimental determination) and n-heptane in linear and non-linear regions, illustrating the utilization of composed ratios. Hydrogen, monolefins, and alkanes of normal and isomeric structure and various molecular weights were the basic products. Separate linear and non-linear radiolysis was carried out considering the initial region, without secondary reactions of the products, to be linear. Radiolysis n-heptane in the non-linear region was obtained on the basis of derived ratios. The yields of the linear region, in molecules per 100 molecules of converted n-heptane at doses of 650 mrad are tabulated. Correlations and analysis of the data show that with increased dose the hydrogen yield is close to linear, while the non-linearity of other components is considerable; the yield of heavy residue is reduced while the yield of non-saturated hydrocarbons is sharply increased, attesting to the non-saturation of the heavy residue in the non-linear region. The mean molecular weight of the yield is reduced with increased radiolysis. (R.V.J.)

17871

PREPARATION OF FLAT POLONIUM HIGH-ACTIVITY ALPHA SOURCES. I. N. Plaksin, V. N. Smirnov, and L. P. Starchik. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 5, 122-3(1959) Sept.-Oct. (In Russian)

The preparation of 250-μc α sources is described. (R.V.J.)

17872

RADIOLYSIS OF METHANOL BY RECOILS FROM THE $B^{10}(n,\alpha)Li^7$ REACTION. Sang Up Choi and Norman N. Lichtin (Boston Univ.) and John J. Rush (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc. 82, 3225 (1960) June 20.

Alpha radiolysis of methanol was studied by irradiating a ca. 0.2 M solution of methyl borate in methanol with thermal neutrons and determining the product yields of H_2, CO, CH_4, CH_2O, and $(CH_2OH)_2$. The alpha and lithium fluxes (total energy 2.35 Mev) from the $B^{10}(n,\alpha)Li^7$ reaction were assumed to be absorbed completely in both the solution and the $FeSO_4$–H_2SO_4 dosimeters. Co^{60} gamma radiolysis of borate-containing methanol was also studied in order to estimate the correction for gamma background in the alpha radiolysis, and the results indicate that borate has little effect on gamma-induced production of CH_4, CO, and $(CH_2OH)_2$, but appears to increase that of CH_2O and decrease that of H_2. The formation of unknown reduction

products in both alpha and gamma radiolysis of methanol is suggested. (D.L.C.)

17873

THE BEHAVIOURS OF FREE RADICALS TRAPPED BY γ-IRRADIATED POLYETHYLENE. Hisatsugu Kashiwabara and Kenichi Shinohara (Japanese Assn. for Radiation Research on Polymers, Tokyo). J. Phys. Soc. Japan 15, 1129(1960) June. (In English)

Free radicals produced by gamma irradiation of polyethylene were investigated with electron spin resonance; the samples were either high-density (HD) or low-density (LD), and the irradiations were done in vacuum at room temperature. The results were plotted on a radical yield vs irradiation dose graph, giving initial G-values (per 100 ev) of 0.5 and 0.3 for HD and LD, respectively. The ratio of yields for HD and LD is proportional to the ratio of their crystallinities, and it is concluded that free radicals are trapped in the crystalline regions. The effects of post-irradiation heating on the yields were also investigated for dose rates of 3×10^7 rad and the results plotted on a yield vs temperature graph. It is seen that yields drop with temperature and that HD retains its yield better than LD; therefore, larger crystallites exist in HD than in LD. (D.L.C.)

17874

REMOVAL OF RADIOACTIVE IONS FROM VERY DILUTE AQUEOUS SOLUTIONS BY CO-PRECIPITATION. U. Sturzer (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie 1, 553-9(1958) July-Aug. (In German)

As a preliminary study for decontamination of radioactive laboratory waste water by co-precipitation with voluminous precipitates, the behavior of very small quantities of individual radioactive ions with different precipitants was checked. In the tests radioactive Po_4^{3-}, Co^{2+}, and Cs^+ ions were precipitated using iron oxyhydrate, aluminum oxyhydrate, copper ferrocyanide, and iron ferrocyanide precipitates. Data are given on dependence of the quantity of co-precipitated radioactive ion on different factors such as pH, precipitant concentration, and equivalent ratio of the precipitant compounds formed in the case of each precipitant used. (tr-auth)

17875

RADIOMETRIC TITRATIONS WITH COBALTICYANIDE (ACCORDING TO THE RADIOACTIVE REAGENT METHOD). U. Stürzer (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie 1, 817-19(1958) Oct. (In German)

Alkali cobalticyanides form difficultly soluble compounds with many metals. It is shown that the reactions of Ag and Ni ions with potassium cobalticyanide can be used for their determination. This is accomplished by a radiometric titration with Co^{60}-labeled potassium cobalticyanide as reagent. (tr-auth)

17876

RADIOLYSIS OF HIGHLY ENRICHED OXYGEN-18 WATER SOLUTIONS CONTAINING HYDROGEN PEROXIDE-16,16. Michael Anbar and Shmuel Guttmann (Weizmann Inst. of Science, Rehovoth, Israel) and Gabriel Stein (Hebrew Univ., Jerusalem). Nature 187, 57(1960) July 2.

An investigation was made of the action of 200-kvp x rays and 2.9-Mev protons on solutions of approximately 1M hydrogen peroxide-16,16 in water which contained 92 to 95 atomic per cent oxygen-18. Reactions were carried out in the presence and absence of initially added oxygen-16,16 or oxygen-18,18 and in the presence or absence of bromide. The reaction products investigated were oxygen-16,16, oxygen-16,18, and oxygen-18,18 formed during radiolysis as well as the same species formed from the decomposition of the hydrogen peroxide after irradiation. Results show that hydrogen peroxide-18,18 can be formed through a distinct molecular mechanism from water alone, whereas hydrogen peroxide-16,18 results from reactions of $H^{18}O$ radicals or their equivalent with hydrogen peroxide-16,16 according to the reaction $O^{18}H + HO^{16}-O^{16}H \rightarrow HO^{18}-O^{16}H + O^{16}H$. (C.H.)

17877

RADIOLYTIC OXIDATION OF FERROUS SOLUTIONS WITH STANDARDIZED INTERNAL SOURCES OF PHOSPHORUS-32. M. Peisach and J. Steyn (South African Council for Scientific and Industrial Research, Pretoria). Nature 187, 58-9(1960) July 2.

The radiolytic oxidation of ferrous solutions was investigated using standardized internal sources of phosphorus-32. The phosphorus-32 was dissolved in air-saturated 0.8N sulfuric acid containing 10^{-3} M ferrous ions as ferrous ammonium sulfate and 10^{-3} M chloride as sodium chloride. The energy dissipated by the radioactive decay was determined from standardization of the radioactivity by 4π proportional counting as well as 4π liquid scintillation counting. Data are presented graphically. (C.H.)

17878

RADICAL AND MOLECULAR YIELDS IN ACIDIFIED DEUTERIUM OXIDE. K. Coatsworth, E. Collinson, and F. S. Dainton (The University, Leeds, Eng.). Trans. Faraday Soc. 56, 1008-13(1960) July.

Radical and molecular yields for solutions of ferrous sulfate in 0.8 N sulfuric acid in light and heavy water irradiated by 220 kvp x rays were determined by application of the method of Dainton and Sutton and by direct measurement of $G(H_2)$ and $G(D_2)$ in solutions containing small, carefully controlled, concentrations of oxygen. At 20.5°C the values for heavy water are: $G_D = 3.88 \pm 0.08$, $G_{D_2} = 0.38 \pm 0.01$, $G_{OD} = 3.04 \pm 0.11$, $G_{D_2O_2} = 0.77 \pm 0.02$, and $G\text{-}D_2O = 4.61 \pm 0.10$. The rate constant of the reaction $Fe^{2+} + D_2O_2 \rightarrow Fe^{3+} + OD^- + OD$ in 0.8 N sulfuric acid in D_2O was shown to have the Arrhenius parameters $E = 10.2 \pm 0.5$ kcal mole^{-1}, $A = 10^{8.8 \pm 0.4}$ l. mole^{-1} sec^{-1}. The significance of these results is discussed. (auth)

17879

REVERSIBLE CHANGE IN THE SULFHYDRYL GROUP OF CYSTEINE UNDER THE EFFECT OF ACTINIC ENERGY. M. A. Kolomiĭchenko and I. P. Stasevska (Stasevskaya) (Inst. of Biochemistry, Academy of Sciences, Kiev). Ukraïn. Biokhim. Zhur. 32, 331-45(1960). (In Ukrainian)

Experimental data are presented on the changes in the SH- and S-S groups and in the magnitudes of the absorption of cystine and cysteine irradiated with various forms of radiation. Results are included of a study of successive action on the indicated amino acid of x rays followed by light. A specific method for the determination of the SH group is amperometric titration with silver. The quantity of SH groups decreases for all irradiations of cysteine solutions due to oxidation. The change in the light absorption magnitudes of irradiated cystine and cysteine depends to a great extent on changes in the SH and S-S groups. (B.O.G.)

17880

RADIATION CHEMISTRY OF NITROGEN INORGANIC HYDROUS SOLUTIONS. A. K. Pikarev (Inst. of Physical Chemistry, Academy of Sciences, USSR). Uspekhi Khim. 29, 508-24(1960) Apr. (In Russian)

Radiolysis of hydrous solutions of inorganic nitrogen compounds is complicated by various valence states of nitrogen. An analysis is made of radiolytic transformation

mechanisms. The nitrogen bond in hydrous solutions under irradiation, radiolysis of ammonium, hydrazine, and hydroxylamine hydrous solutions, the nitrite yield, the hydrogen yield, formation of nitrogen and nitrogen oxides, and oxidation products are discussed as well as radiolysis of nitric acid and mechanisms of radiolytic reduction of NO_3^- ions. (R.V.J.)

17881

THE INACTIVATION OF LACTIC ACID DEHYDROGENASE WITH SLOW PROTONS. Heinz Kühn (Max-Planck-Institut für Biophysik, Frankfurt am Main). Z. Naturforsch. 15b, 277-84(1960) May. (In German)

Dried lactic acid dehydrogenase in thin layers was irradiated with protons of various energies up to a maximum 80 kev. The inactivation cross section at room temperature was about 0.4×10^{-12} cm^2 and was constant in the measured energy range. The influence of the particle energy on the inactivation pattern was estimated at very low energies. Irradiations at various temperatures showed a decrease of the radiation effect with low temperatures. (tr-auth)

17882

INVESTIGATIONS OF AEROSOLS FORMED DURING RADIOCHEMICAL REACTIONS. V. S. Bogdanov. Zhur. Fiz. Khim. 34, 1044-9(1960) May. (In Russian)

The formation and subsequent changes of aerosols arising during the irradiation of gaseous organic substances by fast electrons under various conditions were investigated by the light beam method. Aerosol particles formed from methane were found to possess radii several microns long and carry both positive and negative charges from 1 to 11 elementary units, the majority (66%) being charged with from 1 to 3 units. The weight concentration and aerosol yield (molecules CH_4 per 100 ev) with respect to the absorbed energy were investigated for aerosols obtained from methane. It was shown that the yield in the case of ethylene is 32 times as high as the maximum achieved in the case of methane. (auth)

Raw Materials and Feed Materials

17883 ANL-5363

Argonne National Lab., Lemont, Ill.

FLUIDIZED-BED PROCESS FOR THE PRODUCTION OF URANIUM TETRAFLUORIDE (GREEN SALT) FROM URANYL NITRATE. Interim Report. A. A. Jonke, N. M. Levitz, E. J. Petkus, and R. G. Taecker. Dec. 30, 1954. Decl. Mar. 7, 1960. 37p. Contract W-31-109-eng-38. OTS.

A proposed new processing technique for the production of uranium tetrafluoride from uranyl nitrate solution is described. This technique involves the application of the fluidized-bed principle for the contacting of gases with powdered solids. A new application of fluidization developed at this Laboratory and applied to the denitration of uranyl nitrate to produce uranium trioxide is also described. The purpose of this work is to develop a low-cost, continuous process for the denitration of uranyl nitrate hexahydrate, the reduction of uranium trioxide to uranium dioxide, and the hydrofluorination of uranium dioxide to uranium tetrafluoride. Uranium trioxide and uranium dioxide powders can be satisfactorily fluidized over a wide range of particle sizes. The product is a powder having a high bulk density and satisfactory physical and chemical properties. Production rates of 100 lb/hr/ft^2 of reactor cross section were demonstrated. Experimental work is continuing to obtain additional information of the effects of operating variables. Experimental work is now underway to determine the optimum hydrofluorination operating conditions and to estimate the size and number of stages required for the production of specification-grade uranium tetrafluoride. (auth)

17884 FMPC-216

National Lead Co. of Ohio, Cincinnati.

A SEMI-EMPIRICAL METHOD FOR ATTAINING PREDETERMINED URANIUM SATURATION LEVELS IN THE SLURREX PROCESS. R. W. Vest. Apr. 24, 1953. Decl. Mar. 2, 1960. 18p. Contract AT(30-1)-1156. OTS.

A method of obtaining any desired saturation of the organic extractant leaving the extraction column of the Slurex process by appropriate calculation of flow ratios has been developed at the FMPC laboratory. The method combines a mathematical equation with empirical data obtained by using constant conditions employed in the process. (auth)

17885 FMPC-391

National Lead Co. of Ohio, Cincinnati.

LABORATORY AND PILOT PLANT EVALUATION OF PORTUGUESE URANIUM CONCENTRATE AND BLACK OXIDE BLENDS. B. G. Ryle, E. J. Beer, J. F. Blum, and T. J. Collopy. Mar. 1, 1954. Decl. Mar. 7, 1960. 18p. Contract AT(30-1)-1156. OTS.

Portuguese uranium ore concentrate was evaluated as a feed material for use in the FMPC refinery. A blend of this concentrate with black oxide in a two to one ratio exhibits digestion and extraction characteristics which are optimum for use under anticipated refinery conditions. (auth)

17886 K-965

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

LOW TEMPERATURE CONVERSION OF URANIUM DIOXIDE TO URANIUM TETRAFLUORIDE USING AQUEOUS HYDROGEN FLUORIDE. J. S. Fox and S. D. Schiffman. Oct. 10, 1952. Decl. Mar. 7 1960. 14p. Contract W-7405-eng-26. OTS.

Over 90% conversion of Mallinckrodt or Hanford uranium dioxide to uranium tetrafluoride was obtained with a stoichiometric excess of hydrogen fluoride. A product suitable for fluorination in the K-25 feed plant was made from this hydrated uranium tetrafluoride by drying at approximately 400°C in an atmosphere of anhydrous hydrogen fluoride. (auth)

17887 K-1043

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

HYDRATION OF URANIUM TRIOXIDE FOR IMPROVING FEED MATERIALS PROCESSING. J. S. Fox. Aug. 10, 1953. Decl. Mar. 7, 1960. 14p. Contract W-7405-eng-26. OTS.

The reactivity of uranium trioxide toward both hydrogen reduction and subsequent hydrofluorination to uranium tetrafluoride was increased by hydration. Two large scale hydration processes were developed which consistently yielded very reactive oxides. The conversion of uranium trioxide to the hydrate may be used in doubling feed production rates in the present feed plant facilities. (auth)

17888 K-1299

Oak Ridge Gaseous Diffusion Plant, Tenn.

DENSIFICATION OF URANIUM TETRAFLUORIDE BY SINTERING. R. A. Carter. Mar. 7, 1957. Decl. Apr. 28, 1960. 14p. Contract W-7405-eng-26. OTS.

A limited study of the densification of UF_4 powder by high temperature sintering in a reducing atmosphere has

shown that the packed density can be increased from 3.1 to 4.1 g/cc by heating to 1680°F for about 30 minutes. A further increase to 4.4 g/cc was achieved by combining pulverized material with a minus 14 plus 16 mesh fraction of the sintered product in a ratio of 3 to 2. (auth)

17889 KDD-207

Carbide and Carbon Chemicals Div. K-25 Plant, Oak Ridge, Tenn.

URANIUM HEXAFLUORIDE MANUFACTURE. K-1131 FEED PLANT PRELIMINARY OPERATING MANUAL. D. C. Brater, B. A. Kress, C. C. Littlefield, R. C. Olson, and S. H. Smiley. July 21, 1950. Decl. Mar. 7, 1960. 172p. OTS.

An operating manual for the ORGDP UF_6 manufacturing plant is presented. Details of operating procedures for plant shakedown, plant startup, normal operations, and plant shutdown are given. Descriptions of the function and control of equipment and specifications and services are included. (J.R.D.)

17890 MCW-160

Mallinckrodt Chemical Works, St. Louis.

THE INSTALLATION OF EQUIPMENT TO CUT DOWN THE DUST AND OTHER LOSSES IN THE TA-7 [UF_4] UNLOADING OPERATION. W. A. Oppold. Dec. 29, 1948. Decl. Mar. 7, 1960. 4p.

Savings of UF_4 are reported, made by the installation of special equipment for handling and milling UF_4. (W.L.H.)

17891 MCW-1380

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. Oct. 1, 1955. Decl. Apr. 28, 1960. 142p. Contract W-14-108-eng-8. OTS.

Chemical analysis and amenability testing of low-grade Chile concentrate indicate that it can be processed as a minor feed blend. The solubility of vanadium as $NaUO_2VO_4 \cdot xH_2O$ in $HNO_3-UO_2(NO_3)_2$ systems was investigated. A study of the extraction behavior of typical feed blends with 25% TBP was initiated. Dibutyl phosphate was shown to be a probable reason for the incomplete stripping of U from TBP–hexane extract. A process for the recovery of U, Th^{230}, and other rare elements from MCW raffinate cake using 100% TBP was investigated. Laboratory preparations and x-ray-diffraction studies were carried out on UO_3 samples. The formation of magnesium uranate during the slag leaching process was investigated. The H_2 content in samples of derby metal was determined. Analytical procedures which were developed included: gasometric determination of H_2 in Mg; vacuum-fusion analysis of U for O_2; ion-exchange separation of sulfate in refined U products; dielectric constant method for determination of TBP in raffinates; and spectrophotometric determination of fluoride. The quantitative reduction of U^{6+} to U^{4+} was also studied. (C.W.H.)

17892 MCW-1381

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART II. Nov. 1, 1955. Decl. Apr. 28, 1960. 207p. Contract W-14-108-eng-8. OTS.

Studies were continued on the following: purification of uranyl nitrate by extraction with TBP in hexane; continuous denitration of raffinates; production of U metal (slugs, ingots, derbies, and dingots); casting of U; fabrication of UO_2 powder; determination of H_2 in U metal; tensile properties of U; and digestion and processing of U metal concentrates. The slag residue plant for U recovery is described. The spray coating of horizontally-split graphite ingot molds was initiated. (W.L.H.)

17893 MCW-1402

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. II. PILOT PLANT WORK. Nona Kuhlman, ed. May 1, 1957. Decl. Mar. 31, 1960. 176p. Contract W-14-108-eng-8. OTS.

Progress is reported on the gross solubility of U in digestions of Mallinckrodt feed materials, studies of variables affecting U purity in a TBP hexane extraction cycle, low-acid flowsheet for TBP–hexane extraction process based on a 440 g U/liter in 1M HNO_3 digest liquor, backmixing studies in the pilot plant pumper-decanter system, recovery of U from residues from the dingot process, lowering the H level in dingot metal, forging of dingot bar stock, dingot extrusion, fabrication of UO_2 fuel elements, and the determination of H content of derby and ingot metal. (W.L.H.)

17894 MCW-1403

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. LABORATORY WORK. Barbara Elliott, ed. July 1, 1957. Decl. Mar. 31, 1960. 198p. Contract W-14-108-eng-8. OTS.

The investigation of the oxidation of chloride by permanganate for chloride removal in the HNO_3 recovery system was continued. Stainless-steel was found to slow the rate of chloride oxidation and increase the rate of permanganate decomposition. The study of factors known to affect the reactivity of UO_3 powders was continued. Solution of ore concentrates in H_2SO_4 plus sufficient HNO_3 to oxidize U to U^{6+} appears feasible as a first step in a wet process for the conversion of ore concentrates to crude UF_4 suitable for fluorination to UF_6. Investigation of a wet process for electrolytic reduction of scrap metal to pure UF_4 was continued. Pyrohydrolysis of MgF_2 slag to MgO appears possible with temperatures of at least 1000°C, a large excess of steam, and good gas-solid contact. An acid leach recovered 90% of the U from C-701 slag in one leach. Direct current was passed through solid U to test the hypothesis that at least a fraction of the H_2 in U is in hydridic form. Vacuum degassing of Mg particles at temperatures above 150°C results in an extremely large increase in the surface area. A new procedure was developed for determining H_2 and H_2O in Mg. Studies of vacuum gas desorption, as a function of temperature, were made on Mg of different particle size. An x-ray spectrographic method was developed for the analysis of U in raffinate cake. The moisture sensitivity of various U concentrates when exposed to a humid atmosphere was determined under different conditions. The possibility of using vapor-liquid partition fractometry for the qualitative identification and determination of the isomeric hexanes was examined. Undiluted TBP as an extractant was studied in conjunction with the alkaline-peroxide colorimetric method for the determination of U. A method is described for the analysis of microgram quantities of Ce in the presence of U. (For preceding period see MCW-1401.) (W.L.H.)

17895 MCW-1404

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART II. PILOT PLANT WORK. Barbara Elliott, ed. Aug. 1, 1957. Decl. Apr. 28, 1960. 160p. Contract W-14-108-eng-8. OTS.

The stoichiometric HNO_3 concentrations required to digest feed materials to 200g U/l, 3N excess acid are tabulated. Stoichiometrically the minimum HNO_3 concentration required to dissolve feed materials to flowsheet conditions

is between 28 and 33 wt.%. A run summary of the low-acid flowsheet tests is presented. The sensitivity of the Weldon Spring TBP-extraction system to process flow rates is discussed. A series of pilot plant experiments are described for removing TBP from raffinate. Steam distillation of the raffinate slurries proved to be more effective than washing with hexone in a pulse column. The flame fusion melting of UO_2 to form dense rods of relatively constant cross section continued. The rods and tubes which were extruded from micronized UO_2 had excellent surface quality and sintered densities greater than 96% of theoretical. Bomb center temperatures of 500°F and higher prior to firing, obtained by increasing the firing time, tended to produce low hydrogen U. A method for producing dingot U with an acceptable H_2 content was developed. A number of solid additions to the UF_4–Mg bomb charge were investigated. The tonnage of forged bar stock produced during this period is given. The variables affecting dingot extrusion are discussed. An investigation of the dingot process is given. The determination of plant decontamination factors for Ce^{3+}, Mg, and Al are presented. (W.L.H.)

17896 MCW-1408

Mallinckrodt Chemical Works, St. Louis.

PILOT PLANT PRODUCTION OF IONIUM CONCENTRATE. R. H. Fariss and G. B. Wills. Nov. 1, 1957. Decl. Feb. 5, 1960. 21p. Contract W-14-108-eng-8. OTS.

The ionium process, as developed during the production cycle, was successful. Production schedules were met with a product of satisfactory purity. Improvements were made with each succeeding cycle with respect to production rate and product quality; however, equipment limitations required that compromises be made in the liquid-liquid extractions. These compromises gave an increased rate of production, but resulted in losses of ionium that might have otherwise been avoided. The basic ionium recovery process of liquid-liquid extraction appears to be amenable to continuous operation with economies in both yield and cost. (auth)

17897 NLCO-613

National Lead Co. of Ohio, Cincinnati.

EVALUATION OF AUSTRALIAN RUM JUNGLE URANIUM CONCENTRATE FOR USE AS NLO REFINERY FEED. Thomas J. Collopy, Carl W. Huntington, Jack F. Blum, Eugene J. Beer, Edward J. Fasnacht, Charles W. Taylor, and Stephen Csepio. Jan. 20, 1956. Decl. Mar. 31, 1960. 20p. Contract AT(30-1)-1156. OTS

A laboratory evaluation of Australian Rum Jungle uranium concentrate showed that the uranium can be satisfactorily extracted by 33.5% TBP-kerosene from an aqueous acid slurry of the material, and that impurities in the aqueous uranyl nitrate product obtained by re-extraction from the organic phase approach NLO tolerance specifications. The uranium values in the organic product were not completely re-extracted at room temperature (10th stage organic, 1.6 g/l U); however, it was assumed that re-extraction will be complete under pulse column conditions (150°F). The results of the Pilot Plant evaluation of Rum Jungle uranium concentrate (Lot No. 1) indicated that this material can be processed employing NLO refinery conditions. The aqueous uranyl nitrate product from the test met all impurity specifications except those for manganese and nickel. The high chloride content of this lot of concentrate will make blending necessary in order to meet NLO feed material specifications. The blending will also lessen the tendencies toward metallic contamination of the OK liquor observed in these tests. (auth)

17898 NLCO-627

National Lead Co. of Ohio, Cincinnati.

THE RECOVERY OF URANIUM FROM COMPOSITE UF_4 REDUCTION BOMB SCRAP BY A TWO-STAGE PHOSPHATE PRECIPITATION PROCESS. E. R. Johnson, A. B. Kreuzmann, E. O. Rutenkroger, R. L. Doyle, and B. C. Doumas. Mar. 1, 1956. Decl. Mar. 31, 1960. 28p. Contract AT(30-1)-1156. OTS.

The results of laboratory and plant studies demonstrated that the U present in HCl leach liquor of C–Oxide can be recovered in the form of a concentrate of low fluoride content by a two-stage phosphate precipitation process. (C–Oxide is a by-product of UF_4 reduction that consists of a 50:50 mixture of MgF_2 slag and dolomite.) In this process, the U is precipitated from the leach liquors at pH 1.5 as $UO_2NH_4PO_4$ (UAP), using H_3PO_4 and NH_4OH as the precipitants. This step serves to separate the U from the F in solution. The UAP cake then is treated with a solution of NaOH which converts the U to a sodium diuranate type compound and at the same time volatilizes the ammonia and solubilizes most of the phosphate present. The dried product contains, on an average, about 60% U, 3 to 5% phosphate, and <0.1% fluoride. (auth)

17899 NLCO-664

National Lead Co. of Ohio, Cincinnati.

LABORATORY AND PILOT PLANT EVALUATION OF ANACONDA BLUEWATER URANIUM CONCENTRATE. Bernard G. Ryle, Eugene J. Beer, Thomas J. Collopy, and Carl W. Huntington. Jan. 17, 1957. Decl. Mar. 31, 1960. 21p. Contract AT(30-1)-1156. OTS.

Laboratory and pilot plant amenability tests showed that Anaconda Bluewater uranium concentrate, containing 4.5% V (U-basis), can be processed satisfactorily in the plant extraction equipment under standard flowsheet conditions. The uranyl nitrate hexahydrate product is within the purity specification limits imposed. (auth)

17900 NLCO-665

National Lead Co. of Ohio, Cincinnati.

LABORATORY EVALUATION OF SOUTH AUSTRALIAN RADIUM HILL URANIUM CONCENTRATES (AMMONIUM PRECIPITATE AND MAGNESIUM PRECIPITATE). Bernard G. Ryle, Thomas J. Collopy, and Eugene J. Beer. Jan. 18, 1957. Decl. Mar. 31, 1960. 21p. Contract AT(30-1)-1156. OTS.

Laboratory amenability tests conducted on advanced samples of ammonium precipitate and magnesium precipitate (uranium concentrates) produced from South Australian Radium Hill showed that the ammonium precipitate can be processed through digestion and extraction to yield a uranyl nitrate product that meets all established product purity specifications with the exception of As and Pb. Further evaluation under pilot plant pulse column conditions is necessary to firmly establish whether the high As and Pb values will be encountered under production refining conditions. The Mg precipitate can be processed satisfactorily to meet U recovery and to produce a product within the purity specification limits imposed. (auth)

17901 NLCO-666

National Lead Co. of Ohio, Cincinnati.

STRIPPING AGENTS FOR RE-EXTRACTION OF URANIUM IN A URANYL NITRATE HEXAHYDRATE–TRIBUTYL PHOSPHATE–NITRIC ACID SYSTEM. Philip S. Gentile and Thomas J. Collopy. Dec. 14, 1956. Decl. Mar. 31, 1960. 48p. Contract AT(30-1)-1156. OTS.

A number of compounds were tested as stripping agents for re-extraction of U in a $UO_2(NO_3)_2 \cdot 6H_2O$–TBP–HNO_3 system. Urea is the most promising reagent, since it ex-

hibits good stripping characteristics and excellent phase disengagement. The re-extraction of U with 8.5M urea solutions at a 5 to 1 organic to aqueous ratio is efficient. The recovery of uranium from the Refinery product solution is practical. The organic raffinate is unaltered by contact with urea solutions. Methods investigated for use in the recovery of urea from urea nitrate, include ion exchange, and ion exclusion adsorption resins. (auth)

17902 NLCO-669
National Lead Co. of Ohio, Cincinnati.
LABORATORY AND PILOT PLANT EVALUATION OF SYNTHETIC CARNOTITE URANIUM CONCENTRATE. Bernard G. Ryle, Eugene J. Beer, Thomas J. Collopy, and Edward J. Fasnacht. Feb. 1, 1957. Decl. Mar. 28, 1960. Contract AT(30-1)-1156. OTS.

Laboratory and Pilot Plant amenability tests conducted on advanced samples of Synthetic Carnotite have shown that: the chloride content of the feed material exceeds the maximum tolerable concentration by a factor of 75. Blending requirements necessary to hold the chloride content within established limits would reduce to an impractical level the rate at which the material could be fed to the Refinery. Reduction of the chloride content in the milling process would, however, make this an acceptable feed material. The digestion and extraction characteristics of a two-to-one blend of Synthetic Carnotite to a material containing negligible vanadium content show that such a blend can be processed in the production plant to meet U recovery specifications. The V concentration of such a blend (7.03% on a U basis) can be tolerated in the National Lead tributyl phosphate system. A U product containing <20 ppm V is produced. (auth)

17903 NLCO-670
National Lead Co. of Ohio, Cincinnati.
SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1957 TO MARCH 31, 1957. John W. Simmons, ed. Decl. Apr. 28, 1960. 155p. Contract AT(30-1)-1156. OTS.

Uranium concentrates containing as much as 2% Th (U_3O_8 basis) can be processed to produce specification grade material in the FMPC Refinery. Anaconda, Uravan, and Naturita ore concentrates were investigated for proposed pilot-scale reduction and hydrofluorination studies. Laboratory studies indicated the effect of SO_4^{2-}, Na, and PO_4^{3-} impurities upon the rate of reduction of UO_3 to UO_2. Differential thermograms and x-ray diffraction patterns are given for various samples of UO_3. A study has been initiated to determine the feasibility of substituting ammonium diuranate for UO_3 in the production of UO_2. The moving bed reactor gave a >90% conversion to UF_4 as a result of better temperature control. UO_2 was produced by reduction of UO_2F_2 with H_2 in a heated vertical reactor. The continuous reduction of UF_4 with Mg and the continuous pouring of molten slag produced during the reduction was accomplished in a cylindrical graphite reactor heated by an induction coil. Modifications which have been made in the equipment for centrifugally casting slugs have resulted in improved slug surfaces. An instrument has been developed which is expected to differentiate U fuel elements having dissimilar degrees and types of preferred orientation. The investigation of the drying characteristics of various U concentrates was continued. The U^{235} content of slightly enriched uranium materials is determined by a neutron activation technique. Laboratory calcination of U_3O_8 at 1500°F for periods of up to six hours has been shown to result in a reduction of fluoride content to 0.1% or less. (auth)

17904 NLCO-683
National Lead Co. of Ohio, Cincinnati.
ACETATE PROCESS FOR THE PRODUCTION OF THORIUM FLUORIDE. Philip S. Gentile and Myron D. Snyder. Feb. 11, 1957. Decl. Apr. 28, 1960. 19p. Contract AT(30-1)-1156. OTS.

An acetate process for producing thorium fluoride was demonstrated to be feasible on a laboratory scale. The process is based on the conversion of thorium nitrate tetrahydrate to anhydrous thorium acetate, with subsequent rapid hydrofluorination at low temperatures to thorium tetrafluoride. A modified analytical procedure was demonstrated for determining the per cent fluoride present in ThF_4–$Th(Ac)_4$ mixtures. (auth)

17905 NLCO-684
National Lead Co. of Ohio, Cincinnati.
SINTERING OF BLACK OXIDE. Karl J. Notz, Jr. Apr. 10, 1957. Decl. Mar. 28, 1960. 33p. Contract AT(30-1)-1156. OTS.

The sintering tendencies of black oxide (U_3O_8) produced from thermally-denitrated orange oxide (UO_3) by (a) thermal decomposition to black oxide and (b) H_2 reduction to brown oxide (UO_2) followed by air oxidation to black oxide were evaluated. Samples were subjected to constant temperatures of 500 to 950°C for 15 to 120 minutes in an air atmosphere. Sintering occurred at all temperatures tested, resulting in decreased surface area, with the most significant changes taking place above 600°C and during the first five minutes. Sintering apparently results from the elimination of intraparticle voids rather than by agglomeration. An empirical relationship between the specific surface area of black oxide and the time for H_2 reduction of black oxide to UO_2 is established. The theoretical considerations concerning this relationship are elucidated. (auth)

17906 NLCO-687
National Lead Co. of Ohio, Cincinnati.
LABORATORY EVALUATION OF AUSTRALIAN EL SHARANA PITCHBLENDE. Jerome H. Krekeler and Joseph R. Nelli. Aug. 29, 1957. Decl. Mar. 28, 1960. 10p. Contract AT(30-1)-1156. OTS.

A comprehensive analysis of Australian Pitchblende ore has been presented. Laboratory digestion and extraction tests have indicated that no problems should be encountered in processing this ore in the Refinery. An estimate of the quantity and the composition of the residues resulting from raffinate processing was prepared. (auth)

17907 NLCO-692
National Lead Co. of Ohio, Cincinnati.
REFINING OF THORIUM-CONTAINING URANIUM CONCENTRATES BY EXTRACTION WITH TRIBUTYL PHOSPHATE. Carl W. Huntington. Aug. 29, 1957. Decl. Apr. 28, 1960. 31p. Contract AT(30-1)-1156. OTS.

A method of refining Th-containing U concentrates by extraction with TBP was developed from laboratory and pilot plant data and was demonstrated in the National Lead Co. of Ohio Refinery. In the separation of Th and U by TBP, complications arising from the high selectivity of the solvent for both elements were overcome by the use of phosphate for preferentially complexing the Th in the aqueous feed slurry. Specification product (<50 ppm Th, U basis) can be obtained from feed materials containing as much as 2% Th (U_3O_8 basis), if the feed slurry contains 15% phosphate (U basis). Other approaches to Th–U separation were found to be less successful than phosphate complexing and are reported briefly. (auth)

17908 NLCO-741
National Lead Co. of Ohio, Cincinnati.
LABORATORY EVALUATION OF RAMAPO URANIUM GRAVITY CONCENTRATE. Jerome H. Krekeler, Clark T. Hicks, and Joseph R. Nelli. Apr. 8, 1958. Decl. Mar. 28, 1960. 11p. Contract AT(30-1)-1156. OTS.

The laboratory evaluation of Ramapo uranium concentrate is presented in this report. The number and level of contaminants not meeting the FMPC feed materials impurity tolerance limits will require that the concentrate be handled as a special feed material. That is, sufficient blending (>4/1) of high quality concentrate to Ramapo will be required in order to meet operational impurity tolerance limits. Then a two-pass refinery operation will be necessary to give acceptable product purity. The radium content of this concentrate requires that it be classified as a "hot" feed and that all first-pass raffinate be considered "hot." Laboratory digestion and batch extraction tests indicate that no problems should be encountered in digesting this concentrate and that it exhibits favorable extraction characteristics. Therefore, this concentrate could be processed through the Refinery, but only by interrupting refinery operations and increasing processing costs. (auth)

17909 NP-8738
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.
MONTHLY REPORT OF DEVELOPMENT, APRIL 1960. 22p. (D60-4).

Standard carbonate leach tests which were performed on mill heads indicated that barren solution is as effective as synthetic solution in leaching. Pilot plant extraction tests using surfactant Aerosol OT (di'2-ethyl-hexyl'sodium sulfosuccinate) resulted in improved uranium extraction in carbonate leaching. In continuing studies on the control of the alkaline precipitation process by conductimetry, graphs are presented to determine the correct resistance for full temperature compensation in barren and pregnant liquors. No serious corrosion of stainless steel by a 30% HNO_3 solution containing 700 ppm chloride and 0 to 60 ppm fluoride nor a 30% HNO_3 solution containing 700 ppm chloride and 0 to 110 ppm fluoride was observed. Microphotographs of N.R. U. rods, obtained from studies on grain size and structure, are presented. The fabrication of ADU pellets by batch production was discontinued in favor of a continuous process in a rotary kiln. The product was not so satisfactory as the one obtained from batch preparations. Batch reductions of ADU at 600°C (an observed optimum temperature) revealed an average sintered density of 10.56 g/cc. (For preceding period see NP-8675.) (C.J.G.)

17910 NYO-1351
Mallinckrodt Chemical Works, St. Louis.
REPROCESSING OF URANIUM BEARING BARIUM SULFATE CAKE PRODUCED IN THE M.C.W. REFINERY. A. M. Kirby. May 1, 1953. Decl. Mar. 7, 1960. 30p. Contract W-14-108-eng-8. OTS.

This report describes work done in the pilot plant at Mallinckrodt toward development of a recovery process for U in $BaSO_4$ cake. The investigation involved examination of chemical leaching problems, and testing of filtration equipment for recovery of the leached cake. Several additional problems uncovered during the work were introduction of the $BaSO_4$ cake into a slurry, settling of heavy fines in process equipment, and foaming of the $BaSO_4$ slurry. (auth)

17911 NYO-2043
New Brunswick Lab., AEC, N. J.
SUMMARY REPORT ON THE LONG RANGE PROGRAM FOR THE PERIOD MAY 1, 1953 TO JULY 31, 1953. C. J. Rodden. Oct. 1953. Decl. Mar. 7, 1960. 131p. OTS.

Moving Bed Process for the Production of UO_2 and UF_4. Studies were made on the reaction kinetics of the reduction of UO_3 with steam and H_2, of the fluorination of UO_2 pellets in a multiple-tube reactor, and of the fluorination of UO_2 pellets with steam and HF. Investigations were made on the pelleting characteristics of different UO_3 materials. Large-scale extrusion of UO_3-H_2O mixtures was undertaken. The reduction of UO_3 and the fluorination of UO_2 in a 2- and a 4-in. reactor were described. The bulk density, shear strength, attrition strength, and volume changes (during reaction) of pellets of UO_2, UO_3, and UF_4 were determined. Production of U from U Oxides. The effect of leaching $U-CaO$ mixtures with 5% HNO_3 and techniques for washing the leached powder were studied. Extractive Distillation of HF from Aqueous Solutions. The operation of the HF extractive distillation pilot plane is described and evaluated. Further work was done on the $HF-H_2SO_4-H_2O$ vapor-liquid equilibrium system and on the corrosion survey of construction materials. Studies on Spray Calcined UO_3. Powdered UO_3 was successfully produced by Bowen Engineering Co. from molten $UO_2(NO_3)_2 \cdot 6H_2O$ by spray calcination. This UO_3 was pelleted. The pellets were more reactive during reduction and fluorination than did those made from Mallinckrodt UO_3, but the physical properties were not so good. (W.L.H.)

17912 NYO-2046
New Brunswick Lab., AEC, N. J.
CURRENT PRACTICES OF REPORTING SPECTROCHEMICAL RESULTS OF URANIUM SAMPLES. H. R. Mullin, ed. Feb. 1954. Decl. Mar. 7, 1960. 105p. OTS.

Tables of spectrochemical analysis data on U metal, orange oxide, and green salt are presented. These data may be used for reference and for comparison of the analytical results from various spectrochemical laboratories. (J.A.G.)

17913 NYO-5029
Mallinckrodt Chemical Works, St. Louis.
GREEN SALT PILOT PLANT FINAL REPORT. Mar. 22, 1943. Decl. Mar. 7, 1960. 55p. OTS.

The production of UF_4 was accomplished in the pilot plant in the following manner: Anhydrous hydrofluoric acid was evaporated and passed over heated UO_2 contained on carbon trays. The hydrofluoric acid reacted with UO_2 to form UF_4. The water given off in the reaction together with excess hydrofluoric acid, was led to an absorption tower and discarded. The details of the process including equipment, operating procedures, and necessary precautions, together with such changes as were advisable or necessary are discussed. (J.R.D.)

17914 NYO-5077
Mallinckrodt Chemical Works, St. Louis.
A STUDY OF CONTINUOUS EXTRACTION METHODS. Thomas C. Furnas, Jr. May 12, 1945. Decl. Mar. 7, 1960. 180p. Contract W-7405-eng-1. OTS.

In an effort toward the adoption of a method of continuous extraction and purification of $UO_2(NO_3)_2 \cdot {}^6H_2O$ solution as a plant process, a series of experiments relating to the problems involved in such a process was conducted. The process comprised three major operations: First, and most important, the extraction of $UO_2(NO_3)_2 \cdot {}^6H_2O$ from its aqueous HNO_3 solution by ether; second, the extraction of rare earth and other impurities from the first obtained ether solution of $UO_2(NO_3)_2 \cdot {}^6H_2O$ by washing with distilled water; and third, the extraction of purified $UO_2(NO_3)_2 \cdot {}^6H_2O$ from its ether solution by distilled water. The experiments and dis-

tribution curves described indicate that the most desirable extraction conditions are obtained by using a feed liquor which contains both an excess of HNO_3 and a salting out agent such as $CaNO_3$ and a solvent containing HNO_3. Major problems are considered which are encountered in extending a laboratory process to plant production scale. (J.E.D.)

17915 TID-10112
National Lead Co. of Ohio, Cincinnati.
SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1955 TO MARCH 31, 1955. J. W. Simmons, ed. Apr. 15, 1955. Decl. Apr. 28, 1960. 170p. Contract AT(30-1)-1156. OTS.

A study of synthetic carnotite blended with U_3O_8 indicated a product which meets specifications with respect to U recovery. The determination of Th and U, evaluation of 33.5% TBP extraction flowsheet, the effect of Al on fluoride volatilization, moving bed reactor for production of UF_4, and a study of the reduction-to-metal process are discussed. The recovery of U from scrap materials and corrosive effects of ammonium uranates are outlined, together with a general review of the work on Th development and analytical determinations. (W.L.H.)

17916 WIN-116
National Lead Co., Inc. Winchester Lab., Winchester, Mass.
QUARTERLY REPORT, JANUARY 1, 1960–MARCH 31, 1960. Arthur C. Herrington, comp. and ed. 38p. Contract AT(49-6)-924. OTS.

Three methods for the determination of radium were evaluated. In two methods, the radium is finally precipitated with barium sulfate as carrier and alpha-counted. In the other method, the radium is recovered in a carrier-free condition for alpha counting. A method for determining radium by removing interfering elements with solvent extraction technniques and precipitating the radium with barium sulfate is described. A method which gives a rapid estimation of radium isotopic composition in samples, based on precipitation with barium sulfate, conversion to the carbonate, and alpha counting, is described. Flowsheets are contained on all five processes discussed. Two processes for the determination of thorium were evaluated. One method consists essentially of extraction of carrier-free thorium in TTA-benzene, stripped in nitric acid, and direct plating of the nitric acid solution for counting. The second method consists of thorium precipitation on lanthanum hydroxide, then on lanthanum fluoride, dissolution in nitric acid aluminum nitrate, thorium extraction into TTA solution, stripping into nitric acid, and counting. Flowsheets for the processes are given. The effects of pH, sulfate ion concentration, calcium and other contaminants, and temperature on the adsorption of radium from acid leach liquors by barite were studied. Coprecipitation studies of radium with barium sulfate from mill effluent streams were investigated. (For preceding period see WIN-115.) (C.J.G.)

17917
THE GUEUGNON PLANT: ITS ROLE IN THE TREATMENT OF URANIUM ORES IN FRANCE. R. Bodu. Bull. inform. sci. et tech. (Paris) No. 38, 38-43(1960) Mar. (In French)

The uranium processing plant at Gueugnon and the procedures used there are described. Treatment of poor and rich ores is discussed, and the flowsheet is presented. (J.S.R.)

17918
PRIVATE INDUSTRY SHOWS HOW TO SIMPLIFY UF_6 OUTPUT. C. S. Cronan, ed. Chem. Eng. 67, No. 14, 70-2 (1960) July 11.

Crude U ore concentrates were successfully converted to pure UF_6 on a plant scale (5,000 tons/yr), using new fluid-bed and distilling techniques. The plant operation process is: (1) direct fluid-bed reduction of U_3O_8 to UO_2, (2) fluid-bed hydrofluorination of UO_2 to UF_4, (3) fluid-bed fluorination of UF_4 to UF_6, and (4) distillation of liquid UF_6 to pure UF_6 product. In (1), solvent extraction, previously a necessary step before reduction, is eliminated. For (2), two reactors in series are used to control temperatures, and the reversible reaction is driven more nearly to completion. For (3), two fluid-bed fluorinators in parallel are used. For (4), two distilling columns are used, one for removal of low-boiling impurities and the other for high-boiling impurities. The feed ore concentrates are leached with acid instead of with sodium carbonate which plugs the bed in all steps, and they must not have too high an impurity concentration. (D.L.C.)

Separation Processes

17919 CF-60-2-56
Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT [FOR] FEBRUARY 1960. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson. May 18, 1960. 88p. OTS.

Vibratory compaction using air-operated piston type vibrators with accelerations up to 150 gees and frequencies up to 85 cycles/sec produced densities up to 8.2 g/cc. A test facility is being installed to study helium coolant purification for the GCR. Thorium dioxide particle size obtained by flame preparation appears to be limited by particle division within the reflected flame since the liquid particle droplets are formed large enough to produce thorium dioxide particles many times the size observed. The density of thorium dioxide pellets increased from 8.3 to 9.2 g/cc when the firing temperature increased from 1220°C to 1470°C. Solution sulfate concentration may be an important variable in the rate of uranium loading on nitrate equilibrated anion exchange resin. The Darex dissolution of bundles of stainless steel tubes showed that the braze material generally dissolved slower than the tubing. Sulfex stainless steel loadings from 23 to 30 g of stainless steel per liter were obtained at reaction rates of 1.36 to 1.96 mg/sq cm-min for F/S values from 0.04 to 0.08 cm/min. Installation of equipment in the High Level Segmenting Facility for the mechanical dejacketing of stainless steel-jacketed NaK-bonded uranium fuel of the SRE Core I is virtually completed and operational shakedown tests are in progress. Acid compositions of the liquid and vapor phase during distillation of uranyl nitrate-nitric acid-water solution were obtained for high uranium concentrations. Temperature appears to have a significant affect upon the dissolution of Zr-2 elements in fused salt. Waste calcination runs 26 and 27 were made with Purex type waste and a mathematical model for heat transfer and solids deposition is presented. (auth)

17920 HW-24989
Hanford Works, Richland, Wash.
LIQUID-LIQUID DISPERSIONS AND THE SIGNIFICANCE OF THE DISENGAGING TEST. L. L. Burger, R. L. Dillon, and W. F. Johnson. July 10, 1952. Decl. Mar. 28, 1960. 12p. Contract W-31-109-Eng-52. OTS.

A summary of observations on the rate of disengaging of liquid-liquid systems is presented. Particular attention is directed to the behavior of hexane impurities, solids, and

other abnormal components of the aqueous Redox streams. (J.R.D.)

17921 HW-28492
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SEMIWORKS STUDIES FOR THE REDUCTION OF CORROSION-PRODUCT IMPURITIES IN UR-PLANT UO_3. L. C. Amos, B. E. Kirkendall, and K. L. Adler. July 2, 1953. Decl. May 4, 1960. 10p. OTS.

Uranium recovery plant UO_3 powder frequently contains excessive amounts of iron, chromium, and nickel. A description of the work carried out in semiworks equipment to define the factors contributing to high corrosion-product contamination is given. Recommendations for reducing the impurity level to meet specifications are included. (J.R.D.)

17922 HW-33901(Del.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DUAL FUNCTION SYSTEM FOR GAMMA RADIATION MONITORING IN AN EXTRACTION PROCESS PILOT PLANT. M. B. Leboeuf, R. E. Connally, and L. F. Miller. Nov. 18, 1954. Decl. with deletions Feb. 5, 1960. 37p. Contract W-31-109-Eng-52. OTS.

A system is described for automatically sampling and monitoring the gamma radiation of solutions in a pilot plant for the processing of spent nuclear fuels. Gross activity levels can be measured in the range six mc/l to three c/l, and gamma energy analysis can be made in the range 10 mc/l to 100 mc/l. The system devised provides for automatic repetitive measurement of the gamma activity of eleven process streams at 30-min intervals, but is readily adapted to continuous measurement of each stream activity when continuous sampling is feasible. The problems which had to be solved, and the design philosophy which was used in developing the system are presented. (auth)

17923 HW-61110
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DECONTAMINATION. P. S. Kingsley and M. L. Short. June 1, 1960. 32p. Contract AT(45-1)-1350. OTS.

A review of the development of decontamination procedures for large, high unit cost, chemical processing equipment is presented. Such equipment may be used in separating fission products from non-fissioned material contained in irradiated plutonium-producing fuel elements. Stainless steel constructions permit the use of aggressive chemicals including strong acids to dislodge the contaminated particles. The optimum procedures are generally dictated by what is to be decontaminated and the particular contaminants present. In most cases the contaminants are fission products ranging from 0.1 Mev gamma energy to 0.75 Mev level. Occasionally plutonium is also encountered as a contaminant. Decontamination data and photographs of equipment and facilities at HAPO are included. (J.R.D.)

17924 HW-63175
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DEVELOPMENT AND TESTING OF AN IMPROVED AGITATOR FOR THE REDOX AND PUREX SEPARATIONS PLANTS. J. Dunn and R. J. Sloat. Dec. 24, 1959. 6p. Contract AT(45-1)-1350. OTS.

A simplified, low-speed, direct drive agitator was constructed and tested under conditions simulating those to be encountered in both the Redox and Purex Plants. All gear-reduction drives were eliminated by employing a special hollow-shaft 300 RPM electric motor and the probability of metallic fatigue was eliminated or reduced by using a 4 inch diameter hollow shaft. The unit was evaluated with the four different shaft lengths of interest in both plants and has proven to be free from critical speed difficulties. Agitation and uniform blending of the contents of a 10-ft diameter by 10-ft deep tank were accomplished in approximately one minute. Durability was demonstrated by over 21,000 hours of operation of a similar agitator and by approximately 2500 hours of operation of this interchangeable unit. The operation has been vibrating free and satisfactory agitation of process solution has been obtained. On the basis of the satisfactory testing the hollow shaft agitator is recommended for use as required within the separations plants. Its adoption will eventually provide a single agitator design for universal use in either the Redox or Purex Plants. (auth)

17925 KAPL-602
Knolls Atomic Power Lab., Schenectady, N. Y.
EQUILIBRIUM DATA FOR PUREX SYSTEMS. J. W. Codding, W. O. Haas, and F. K. Heumann. Nov. 26, 1951 Decl. Feb. 4, 1960. 31p. Contract W-31-109-Eng-52. OTS.

Diagrams show the distribution of $UO_2(NO_3)_2$, HNO_3, $Pu(NO_3)_4$, and $Th(NO_3)_4$ in various TBP-Gulf BT Purex systems. The distribution data and equations necessary for calculation of the diagrams are presented with equations for the correction of $UO_2(NO_3)_2$ and HNO_3 distributions made necessary by small variations in the original TBP concentrations. The method used for extrapolation of the $UO_2(NO_3)_2$ and HNO_3 distribution data as well as the bases for the equations given in the report are included in the appendixes. (D.E.B.)

17926 KAPL-M-FCS-1(Vol.II)
Knolls Atomic Power Lab., Schenectady, N. Y.
AN INDEX AND SUMMARY OF CHEMICAL WORK ON THE REDOX ASSISTANCE TO HANFORD PROGRAM. VOLUME II. PART III. REDOX PILOT PLANT DEVELOPMENT STUDIES. W. S. Andrus, E. J. Reber, and F. C. Steiner. Apr. 1, 1953. Decl. May 4, 1960. 88p. Contract W-31-109-Eng-52. OTS.

Head-end studies with the Separations Process Research Unit (SPRU) resulted in the improvement of the treatment methods for the removal of contaminants from the dissolver solutions while maintaining low plutonium losses. Data indicated that ozone sparging was unnecessary in the removal of ruthenium following its oxidation with $KMnO_4$; thus the ruthenium could be removed by a steam or nitrogen sparge. Zirconium and niobium were scavenged by a manganese dioxide precipitate. Using this type treatment, average log decontamination factors of 5.4 and 5.0 were obtained for gross beta and gamma, respectively. A similar nonhead-ended run resulted in factors of 4.1 and 4.0 respectively. This latter process resulted in uranium and plutonium losses of 0.30 and 0.10% under average operating conditions. (B.O.G.)

17927 NAA-SR-220
North American Aviation, Inc., Downey, Calif.
SEPARATIONS CHEMISTRY PROGRESS REPORT FOR THE PERIOD OCTOBER, NOVEMBER AND DECEMBER 1952. E. Motta and M. Yardley, eds. Jan. 30, 1953. Decl. May 3, 1960. 59p. Contract AT-11-1-GEN-8. OTS.

Progress of the work in high temperature compact separations methods for processing nuclear fuels to achieve Pu and Np separation and U recovery, adaptation of the fluo-

ride volatility process to various fuel materials, and radiation effects on the newer separations processes applied to short cooled nuclear fuels is described. (B.O.G.)

17928 NAA-SR-4885
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
DECONTAMINATION OF THORIUM BY ELECTROLYSIS: A THEORETICAL DISCUSSION. W. N. Hansen. June 15, 1960. 20p. Contract AT-11-1-GEN-8. OTS.

A thermodynamic analysis was applied to the electrorefining of impure thorium in a molten chloride system. The equations $D = D_n = \exp[nF/RT \mid E^0_M - E^0_{Th}|]$ were derived, which relate the decontamination factor to the difference in electrode potentials of thorium and impurity metals. Decontamination factors for various fission products were calculated, from this equation, for a temperature of 1000°K, some being greater than 10^{10}. The decontamination factors for active metals will decrease with time, while those for the inactive metals should remain constant. (auth)

17929 ORNL-557
Oak Ridge National Lab., Tenn.
TBP PROCESS FOR URANIUM RECOVERY FROM METAL WASTE — LABORATORY SUMMARY. T. C. Runion and C. V. Ellison. Jan. 18, 1950. Decl. Apr. 21, 1960. 65p. Contract W-7405-eng-26. OTS.

In countercurrent batch studies, decontamination factors of 1×10^4, and U losses of <0.2% were demonstrated for the tributyl phosphate extraction of U from metal wastes. The operability of the process was satisfactorily demonstrated with feed solutions containing 0.1 to 0.6 M U (20 to 140 g/l), 0 to 1.3 M sulfates, and 0 to 0.7 M phosphates. Acidified Hanford waste supernatant, to which was added the necessary ionic constituents to simulate total waste, was used as feed solutions in these experiments. In all cases, the recovered U contained less than 20% of the beta activity of natural uranium and only background γ-activity. It was shown that the Pu to U ratio in the product could be reduced to $\sim 1 \times 10^{-6}$ by using 0.05 M ferrous sulfamate in the scrub stream. Scouting studies indicated that by eliminating the scrub section entirely, as much as 80 to 90% of the Pu may be extracted with the U, and subsequently separated and recovered by stripping with ferrous sulfamate. The U remained in the organic phase and was stripped with water in a third column. For old wastes, this procedure would not appreciably alter the decontamination from fission product activity. Methods of feed preparation, solvent specifications, cleanup procedures, analytical methods, and variables affecting Pu extraction were investigated. (auth)

17930 ORNL-1210
Oak Ridge National Lab., Tenn.
CORROSION DATA FROM THE ORNL PUREX PILOT PLANT ACID RECOVERY EQUIPMENT. J. W. Landry and J. W. Ullmann. Mar. 25, 1952. Decl. Apr. 21, 1960. 69p. Contract W-7405-eng-26. OTS.

Details are presented for the metallurgical examination of materials such as steels, Ta, and Ti located throughout the ORNL Purex Pilot Plant Nitric Acid Recovery Unit. The corrosion data reported include the effect of decontamination treatments. Materials of construction suitable for the Purex acid recovery system have been determined. (M.H.N.)

17931 ORNL-2871
Oak Ridge National Lab., Tenn.
SOLUBILITIES OF SELECTED METALS IN MERCURY: HERMEX PROCESS. A. F. Messing and O. C. Dean. June 29, 1960. 20p. Contract W-7405-eng-26. OTS.

The solubilities of uranium, thorium, gadolinium, samarium, and neodymium in mercury were determined from room temperature to 356°C. Equations of the form log of solubility (wt.%) = a + b/T were developed for these metals. Integral heats of solution were calculated for each. The solubilities of ruthenium, palladium, zirconium, and molybdenum in mercury in the presence of excess uranium were determined; the low solubility of zirconium and molybdenum gave solutions with a concentration below the limit of detection in the analytical method used. Their values are reported as an upper solubility limit. Uranium solubility in a 0.1 wt.% magnesium amalgam was approximately 1.2 to 1.5 times greater than in mercury alone. When uranium and thorium were present in the same mercury solution, their solubilities were mutually depressed. (auth)

17932 ORNL-2941
Oak Ridge National Lab., Tenn.
CONTROLLED pH STRIPPING OF URANIUM FROM AMINES. D. J. Crouse. June 15, 1960. 23p. Contract W-7405-eng-26. OTS.

A method for stripping uranium from amines by contacting the extract with an ammonium sulfate solution, while adjusting the pH to 3.5 to 4.5 with ammonium hydroxide, was developed through laboratory scale. Reagent costs are low (~7¢/lb U_3O_8) and the product is a high-assay sodium-free (or low sodium) concentrate. Separations from molybdenum are relatively poor, and somewhat more careful control is required than in certain other available stripping methods. Batch stripping tests demonstrated the strong dependence of the stripping efficiency on pH, stripping of Alamine 336 being relatively difficult below pH 4. Two other tertiary amines, tri(isooctyl) and XE-204, were stripped better, and a branched secondary amine, bis(1-nonyldecyl), poorer than Alamine 336. Increasing the sulfate concentration of the strip solution to 1 to 2 M improved the stripping efficiency slightly. In continuous runs with Alamine 336, some emulsion troubles were encountered at pH ~4 although stripping was effective. At pH 3.3 to 3.8, physical operation was satisfactory but stripping was ineffective, relatively large amounts of uranium reporting to the molybdenum stripping circuit. (auth)

17933 RFP-117
Dow Chemical Co. Rocky Flats Plant, Denver.
EXTRACTION OF URANIUM FROM INCINERATOR ASH LEACH SLURRIES. J. C. Biery. July 30, 1958. Decl. Mar. 28, 1960. 67p. Contract AT(29-1)-1106. OTS.

The possibility of removing uranium by extraction from incinerator ash leach slurries was studied. The incinerator ashes were leached with HNO_3, HCl, H_2SO_4, and H_3PO_4. These slurries were extracted with the following solvents: mono-heptadecylphosphoric acid (HDPA); and di-2-ethylhexylphosphoric acid plus dihexylhexylphosphonate (D2EHPA/DHHP). The solvents satisfactorily extracted the uranium from the HNO_3, H_2SO_4, and H_3PO_4 incinerator ash leach slurries. The HCl leach slurries emulsified. The leached solids were washed more efficiently by slurry extraction than they were by water washing. The 1.0/0.16M D2EHPA/DHHP gave the highest extraction efficiencies of the solvents tested. However, to obtain better phase separation properties, the 0.5/0.1M EH/HH solvent is recommended for process use. (auth)

17934 UCRL-3911(Suppl.)
California. Univ., Berkeley. Radiation Lab.
LONGITUDINAL DISPERSION IN SOLVENT-EXTRACTION COLUMNS: NUMERICAL TABLES. Alice K. McMullen, Terukatsu Miyauchi, and Theodore Vermeulen. Jan. 22, 1958. 31p. Contract W-7405-eng-48. OTS.

Equations governing longitudinal dispersion in countercurrent columns as a function of the rates of dispersion in the two phases, the mass-transfer coefficient, the equilibrium partition ratio, and the rates of fluid flow were solved for a large number of typical conditions by use of an IBM-701. The numerical results are presented in tabular form. (C.J.G.)

17935 AEC-tr-3957

PROBLEM OF MECHANISM OF PLUTONIUM NITRATE EXTRACTION BY MONO- AND DIBUTYLPHOSPHATES. V. B. Shevchenko and V. S. Smelov. Translated by Lydia Venters (Argonne National Lab.) from Atomnaya Energ. 6, 140-4(1959). 10p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 22154.

17936 JPRS-2257

PLUTONIUM PRODUCTION AT MARCOULE. F. G. Translated from Inds. atomiques 3, No. 9/10, 99-102(1959). 9p. OTS.

The operation of the plutonium extraction plant at Marcoule, France, is described. The solvent process is outlined. Subsidiary installations for the plutonium piles and for the plutonium separation chemical plant include a graphite processing plant, installations for stripping irradiated fuel elements, and a station for treating liquid outflows. (C.H.)

17937 UCRL-Trans-540(L)

ION EXCHANGE SEPARATION OF SCANDIUM AND LANTHANIDE ELEMENTS. Jun Yoshimura, Yoshimasa Takashima, and Hirohiko Waki. Translated from Nippon Kagaku Zasshi 79, 1169-72(1958). 9p. JCL.

Good results were obtained in separating scandium and lanthanide elements by a method which used an anion-exchange resin and concentrated hydrochloric acid of over 13N for the eluant and a method which used a cation-exchange resin and a solution mixture of ammonium acetate-acetic acid for the eluant. Since a smaller quantity of eluant sufficed by this method than by other complex-salt elution methods, and since the liquid flowing out vaporized completely merely by heating over a water bath, leaving a solution only of the desired element, this was believed to be effective in the purification and rapid analysis of scandium and rare earth elements. (auth)

17938 UCRL-Trans-541(L)

STUDIES ON METHYL ISOBUTYL KETONE EXTRACTION AND DETERMINATION OF METALLIC SALTS. (FIRST REPORT). EXTRACTION OF IRON, ANTIMONY, TIN, ARSENIC, SELENIUM, TELLURIUM, AND GERMANIUM MAINLY FROM HYDROCHLORIC ACID SOLUTIONS. Hidehiro Goto, Yachiyo Kakita, and Takeshi Furukawa. Translated from Nippon Kagaku Zasshi 79, 1513-20(1958). 21p. JCL.

Basic experiments were conducted toward the use of methyl isobutyl ketone in the extraction of metallic salts. Various commonly handled elements were extracted, mainly from hydrochloric acid solutions, by methyl isobutyl ketone, and the approximate tendencies of extractability were determined. Experiments on iron, antimony, tin, arsenic, selenium, tellurium, and germanium from among those metals which were easily extracted were carried out. Methyl isobutyl ketone extractions were conducted at various concentrations of hydrochloric acid and other acid solutions of these. The metals remaining in the acid solution were determined by methods suitable to each. The quantity of metal extracted was sought, and the per cent extracted was made clear. When conducted under optimum conditions for each metal, approximately 99.9% iron(III), 100% antimony(V), 68% antimony(III), 99% tin(IV), 91% arsenic(III), 28% arsenic(V), 99% selenium(IV), 96% tellurium(IV), and 98% germanium(IV) were extracted. (auth)

17939

MINIATURE HYDROCLONES AS SLURRY CONCENTRATORS. F. C. Engel and Joel Weisman (Westinghouse Electric Corp., Pittsburgh). A.I.Ch.E. Journal 6, 262-7 (1960) June.

Miniature hydroclones were evaluated for use with thoria-urania slurries being considered as fuels for one type of homogeneous nuclear reactor. In addition to extensive room temperature data on concentrating performance, the results of tests with thoria slurries at a pressure of 2,000 lb/sq in. and temperatures up to 550°F are given. The data correlation presented allows prediction of the concentrating performance of a given clone provided that the properties and particle size distribution of the slurry feed are known. (auth)

17940

COEXTRACTION OF TUNGSTEN AND SOME OTHER ELEMENTS. V. I. Kuznetsov and P. D. Titov (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 840-2 (1960) Apr. 1. (In Russian)

The mechanism of tungsten and molybdenum coextraction from hydrochloric acid by aniline in the form of aniline polytungstates and molybdates is discussed. Experiments were carried out with W^{185} and W^{187}, and the influence of molybdate or vanadate on the tungsten distribution factor is tabulated. The extraction and coextraction of other elements which form polymers are described using tungsten and vanadium coextraction with niobium as an example. The results are given for tungsten and molybdenum extraction with weak base amines. (R.V.J.)

17941

THE PULSED COLUMN IN LIQUID-LIQUID EXTRACTION. I. DESCRIPTION AND OPERATION. L. Damiani, A. Doria, and V. Fattore (SICEDISON, Porto Marghera, Italy). Energia nucleare (Milan) 7, 323-32(1960) May. (In Italian)

After a brief introduction of the concepts in liquid phase extraction, the pulse-column application is examined, and a laboratory column is described. Its operation is explained, and the variables which affect its performance are considered. (auth)

17942

SEPARATION OF Pb, Ca, Sr, Ba, AND Ra WITH CATION EXCHANGERS. G. Eulitz (Universität, Heidelberg, Ger.). Nukleonik 2, 85-7(1960) May. (In German)

A method is given for the qualitative separation of the elements Pb, Ca, Sr, Ba, and Ra in cation exchangers by gradient elution in one separation process. The concentration of the radionuclides Sr^{90}, Sr^{89}, Ba^{140}, and Pb^{210} (RaD) in precipitations and in air near the ground was measured with this method. The measurement results of the Sr^{90} concentration in the air from Oct. 1, 1956, to Jan. 1, 1960, were tabulated. (tr-auth)

17943

Argonne National Lab., Ill.

REACTOR FUEL PROCESSING. Technical Progress Review, Vol. 3, No. 2. Stephen Lawroski, ed. 1960. 53p. $0.55(GPO) (domestic) $0.70(GPO) (foreign).

Commercial aspects of fuel processing are discussed in sections on Euratom research and development, AEC chemical processing services, uranium procurement

and production statistics, New York State's plans, reprocessing study group activities, and waste-disposal licensing. Other sections contain discussions of safety in chemical processing, mechanical processing, chemical dejacketing, dissolution, solvent extraction precipitation, ion exchange, volatilization, pyrometallurgy, and aqueous homogeneous reactor fuel processing. Progress in plant design, instrumentation, and equipment development is also examined along with activities in waste disposal, and in the production of uranium, thorium, plutonium, and their compounds. (J.R.D.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

17944 AGARD-213

North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development.

A DESIGN PHILOSOPHY FOR REPEATED THERMAL LOADING. E. W. Parkes. Oct. 1958. 30p.

Presented at the Eighth Meeting of the Structures and Materials Panel, held from 20th to 25th October, 1958, in Copenhagen, Denmark.

Various aspects of designing structures for repeated thermal loading are discussed. The concepts of a statistical safe life for the structure are discussed. Calculations are given for some simple models in which the load was kept constant and the temperature varied cyclically. (C.J.G.)

17945 CF-58-4-93

Oak Ridge National Lab., Tenn.

REMOTE MAINTENANCE EXPERIMENTAL WORK ON A REACTOR SYSTEM PUMP. W. B. McDonald, C. K. McGlothlan, and E. Storto. Apr. 23, 1958. 35p. OTS.

The information presented is an experimentally determined evaluation of standard remote handling equipment applied to the problems associated with remote maintenance of a typical reactor system component. (auth)

17946 DEGR-143(CA)

United Kingdom Atomic Energy Authority. Development and Engineering Group, Capenhurst, Ches., England.

HIGH-TEMPERATURE FLANGED JOINTS INCORPORATING PTFE SEALING GASKETS. W. P. White and N. A. C. Bromidge. Mar. 9. 1960. 10p. BIS.

Tests were made on two types of mild-steel flanged joints incorporating PTFE seals. In one joint the PTFE is in the form of a thin gasket; the other is made with a Wills pressure-filled joint ring, which has its outer surface spray-coated with PTFE. Within the limitations of the tests, it is shown that PTFE provides a satisfactory sealing medium for joints, and that a high vacuum standard is maintained when the joints are thermally cycled from 0 to 400°C. Further development is recommended. (auth)

17947 HW-56537

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

INTERIM REPORT—DT-63 SCALE FORMATION IN HEAT EXCHANGERS USING RAW COLUMBIA RIVER WATER. W. D. Bainard. June 30, 1958. 31p. Contract AT(45-1)-1350. OTS.

An investigation of scale formation on production reactor heat exchange equipment using heated, demineralized water on the tube side, and raw unfiltered Columbia River water on the shell side was conducted. A preliminary conclusion with the test half over is that untreated river water can be used as the cooling medium at 320°F in stainless steel tubed heat exchangers at cooling water outlet temperature of 200°F without prohibitive scaling. (J.R.D.)

17948 NAA-SR-Memo-4442

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

FINAL PERFORMANCE TESTS OF TWO-COOLANT-REGION SODIUM PUMP SHAFT FREEZE-SEALS. F. O. Streck. Feb. 10, 1960. 44p. OTS.

A prototype of the two-coolant-region pump shaft freeze-seals intended for application to the Hallam Power Reactor sodium pumps was fabricated. Tests under simulated reactor service conditions revealed satisfactory operation only when the lower of the two regions received heat from the circulating fluid (tetralin in the tests). With the inlet temperature of tetralin to the upper region of the seal maintained at 95°F and that to the lower region held in the range 240 to 285°F the seal functioned satisfactorily for 1100 hr. When 95°F coolant was circulated through both sections of the seal excessive cooling occurred, resulting in either improper formation of the seal or in seizure of the shaft when rotative speed was low. In this case, the cooling load on the seal varied directly with both shaft speed and bulk sodium temperature. A maximum cooling load of 2.56 kw occurred at a shaft speed of 840 rpm and with a bulk sodium temperature of 1000°F. (C.J.G.)

17949 NAA-SR-Memo-4982

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

INTERIM REPORT ON FILTER SCREENING TESTS. S. J. Sawyer. Mar. 16, 1960. 13p. OTS.

Five filters and several combinations of filter media were tested using OMRE coolant. The Alsop filter and deep bed Celite filter, both of which utilized asbestos pads and Celite, exhibited decontamination factors of 20 to 50. (C.J.G.)

17950 NAA-SR-Memo-5106

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

DESIGN OF TWO ELECTROMAGNETIC PUMPS FOR NaK. R. S. Baker and W. J. Fraser. Mar. 25, 1960. 11p. OTS.

Two types of electromagnetic pumps, d-c conduction and a-c linear induction, were designed to pump NaK (78% K) at 650°F at a rate of 354 gpm with a developed pressure of 20 psi. (C.J.G.)

17951 NP-8772

General Electric Co. General Engineering Lab., Schenectady, N. Y.

GAS BEARING STABILITY STUDY—VERTICAL ROTOR INVESTIGATION. R. C. Elwell, R. J. Hooker, and B. Sternlicht. May 20, 1960. 62p. Contract Nonr-2844(00).

An analytical and experimental study of the stability of vertical rotors, supported by self-acting gas bearings, is reported. Data are included on forced vibration of an unbalanced rotor, unstable rotors with flexible drive, and instabilities of a direct driven (integral electric motor) rotor. Methods of calculating forced vibration amplitudes due to unbalance are presented, based on previous analytical work, and supported by current experiments. The unstable behavior of a variety of rotors is presented, to illustrate the commonness of half-frequency conical whirl, and its persistence. Methods of calculating the "threshold of half-frequency whirl" are given, and verified by experimental results obtained on three different rotors. The

technique predicts the mode of whirl to be encountered, and is a useful design tool. (auth)

17952 SCR-154
Sandia Corp., Albuquerque, N. Mex.
HOW POSITIONAL TOLERANCING CLARIFIES DESIGN INTENT AND REDUCES PRODUCT COST. E. S. Roth. Jan. 1960. 43p. OTS.

The shortcomings of bilateral (coördinate) dimensioning in product drawings as a means of giving engineering information are pointed out using as an example a bilaterally dimensioned plate with four clearance holes for assembling to another identical plate. A new system called positional tolerancing is proposed for inspection criteria for companies with far-flung operations. Paper gage techniques are given for open setup inspection of piece parts. (D.L.C.)

17953 UCRL-5978
California. Univ., Livermore. Lawrence Radiation Lab.
THE MEASUREMENT OF AIR FLOW THROUGH HIGH EFFICIENCY FILTERS. Carl L. Lindeken, Donald N. Montan, and Edgar L. Beard. Apr. 29, 1960. 12p. Contract W-7405-eng-48. OTS.

An inexpensive method for the detection of flow through dust-loaded, high-efficiency filters is described. Air flow is continuously indicated by elementary pitot tubes and plastic rotameters. Accuracy obtained is within ±15%. Information as to construction, installation, and use is presented. (auth)

17954 WADC-TR-59-386
Little (Arthur D.) Inc., Cambridge, Mass.
STORAGE, TRANSFER, AND SERVICING EQUIPMENT FOR LIQUID HYDROGEN. Final Report for May 1, 1958 to July 31, 1959. B. M. Bailey, D. C. Benedict, R. W. Byrnes, C. R. Campbell, A. A. Fowle, R. W. Moore, Jr., W. G. Pestalozzi, E. G. Richter, F. E. Ruccia, and C. A. Schulte. July 1959. 776p. Project No. 6053. Contract AF33(616)-5641. (AD-231635).

A study was made to provide engineering data concerning the most adequate, safe, and economical procedures and equipment for liquid hydrogen storage, transfer, and ground servicing systems. The investigations have centered on the requirements for (1) storage vessels, (2) transfer lines, (3) pumping systems, (4) valves, (5) instruments, and (6) recondensing systems. Results, conclusions, and recommendations are reported in separate chapters classified in accordance with the above-listed hardware items. (auth)

17955
HIGH TEMPERATURE CANNED PUMPS. H. A. Thornton and A. D. Fell, Jr. (Fostoria Corp., Ohio). Chem. Eng. Progr. 56, No. 7, 45-8(1960) July.

Canned pumps eliminate sealing and leakage problems in pumping heat transfer fluids at high temperatures and pressures and hence have considerable potential for use i chemical processing and nuclear industries (e.g., D_2O-moderated reactors and nuclear submarines). The requirements for such fluids are given, and the advantages of high-temperature water systems (HTW) over steam systems are pointed out. Organic liquid and vapor systems are also considered since they extend the range of maximum temperatures without raising the pressure unduly. Applications of canned pumps to industry are discussed at length; a flow diagram is given for a typical pressurized HTW system with canned pumps. (D.L.C.)

17956
USE OF THE OMEGATRON IN THE DETERMINATION OF PARAMETERS AFFECTING LIMITING PRESSURES IN VACUUM DEVICES. David Lichtman (Sperry Gyroscope Co., Great Neck, N. Y.). J. Appl. Phys. 31, 1213-21(1960) July.

The omegatron mass spectrometer was used to determine residual gases in vacuum systems including ion pump systems. The predominant residual gas in ion pumps was found to be methane, while the gases found in oil diffusion pump systems include water vapor and carbon monoxide. Analysis was performed to determine the residual gases in vacuum tubes difficult to outgas, and conditions that lead to considerable hydrogen content are described. Examples of the use of the omegatron mass spectrometer as a tool in aiding solution of outgassing problems are given. (auth)

17957
INTERNATIONAL SYMPOSIUM ON STRESS WAVE PROPAGATION IN MATERIALS. Norman Davids, ed. New York, Interscience Publishers, Inc., 1960. 347p.

A total of 15 papers are presented; some of the topics treated are seismic waves in layered liquids and solids, photoelasticity, armour penetration, scabbing, cinematography, and surface waves. (D.L.C.)

Heat Transfer and Fluid Flow

17958 60-GL-73
General Electric Co. General Engineering Lab., Schenectady, N. Y.
REPORT OF TESTS TO DETERMINE THE EFFECT OF PLATE LENGTH-TO-WIDTH RATIO ON THE PRESSURE DIFFERENTIALS DEVELOPED ACROSS SINGLE ALUMINUM PLATES DIVIDING A FLOW CHANNEL. William L. Zabriskie. Apr. 15, 1960. 24p. Contract W-31-109-Eng-52. OTS.

A series of tests is described in which the effects of length-to-width ratio on the pressure differential developed across single aluminum plates dividing a flow channel are given. Measurements of static pressure differential across the plates were made along their length. These values were recorded for increasing flows until the limit of the facility was reached, or plate deflections exceeded 30% of the channel width. (J.R.D.)

17959 AGC-1672
Aerojet-General Corp., Azusa, Calif.
DETERMINATION OF BURNOUT LIMITS OF SANTOWAX OMP. Final Report [for] Period Covered December 18, 1958—July 10, 1959. T. C. Core and K. Sato. Sept. 15, 1959. 24p. For Atomics International. Div. of North American Aviation, Inc. Contract N9-S-530. OTS.

An experimental investigation was conducted to establish the burnout limits of a mixture of o-terphenyl, m-terphenyl, and p-terphenyl at 19 to 317 psia, 466 to 743°F, 0.78 to 16.8 ft/sec, and 53,000 to 1,218,000 Btu/ft^2 hr. An electrically heated annular test section with an equivalent hydraulic diameter of 0.272 in. was employed. The critical heat flux for this material was correlated by the equation $(Q/A)_c = 407\,\Delta T_{sub}\,V^{\frac{1}{3}} + 100{,}000$ Btu/ft^2 hr. (auth)

17960 NAA-SR-5141
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
A HEAT TRANSFER CONTROL DEVICE FOR IRRADIATION EXPERIMENTS. W. K. McCarty and R. C. Noyes. June 30, 1960. 10p. Contract AT-11-1-GEN-8. OTS.

A device which controls temperatures by varying the heat transfer across an annular space was designed and tested. The central temperature of a nuclear fuel test specimen was controlled at 1165 ± 10°F. The mechanism makes possible temperature control under conditions where the heat source, heat sink, or both vary between 50 and 150% of the nominal value. Out-of-pile tests and three in-pile experiments confirmed the usefulness of the device. (auth)

17961 NDA-2-31
Nuclear Development Corp. of America, White Plains, N. Y.
SPECIAL HEAT TRANSFER PHENOMENA FOR SUPERCRITICAL FLUIDS. Kurt Goldmann. [1956]. Decl. May 3, 1960. 17p. OTS.

Paper presented at Reactor Heat Transfer Conference in New York City on Nov. 1-2, 1956.

Present-day knowledge concerning the molecular structure of supercritical fluids is briefly reviewed. It is shown that liquid-like and gas-like phases may coexist at supercritical pressures, although they may not be in equilibrium with each other. It is postulated that on the basis of the coexistence of these two phases a "boiling-like" phenomenon may provide the mechanism of heat transfer to supercritical fluids at high heat fluxes and certain other conditions. An unusual mode of heat transfer was actually observed at supercritical pressures during tests which produced the high heat fluxes and other conditions under which such "boiling" would be expected. The tests and the various conditions are briefly described. An emission of high-frequency, high-intensity sounds usually accompanied these tests. It is shown that similar screaming sounds were heard during boiling at subcritical pressures, giving further support to the hypothesis that "boiling" may occur at supercritical pressures. A second possible explanation for the unusual mode of heat transfer is based on boundary-layer stability considerations. At high heat fluxes large density differences exist between the bulk of the fluid and the fluid in the boundary layer near the wall. A breakdown of the boundary layer may be caused by the build-up of ripples between its low-density fluid and the high-density bulk fluid, in a manner quite similar to the breaking of ocean waves at high wind velocities. It is pointed out that the density variation of supercritical fluids may be used to advantage by centrifuging boundary layers. (auth)

17962 NOTS-1756
Naval Ordnance Test Station. Underwater Ordnance Div., Inyokern (China Lake), Calif.
TEMPERATURE TABLES. PART I. ONE-LAYER PLATE, ONE-SPACE VARIABLE, LINEAR. Charles J. Thorne. July 18, 1957. 715p. (NAVORD-5562(Pt.I)).

Tables are presented which give values of temperature at various points and times in a flat plate of one material with heat transfer or no heat transfer at both flat faces. Temperature is considered as a function of distance from one face and time. Heat transfer at a surface is assumed proportional to the difference between the temperature of the surface and an outside temperature. (C.J.G.)

17963 NP-8780
Michigan. Univ., Ann Arbor. Research Inst.; Chrysler Corp., Detroit; and Atomic Power Development Associates, Inc., Detroit.
FREE CONVECTION HEAT TRANSFER AND FLUID FLOW IN CLOSED VESSELS WITH INTERNAL HEAT SOURCE. F. G. Hammitt, E. M. Brower, and Paul T. Chu. 1959. 85p. OTS.

Little or no engineering data are available for the evaluation of temperature differentials, fluid velocities, and wall heat flux distributions in heat transfer under conditions of natural convection in a closed vessel. In order to offset this lack, experimental and analytical investigations were conducted covering cases of axial symmetry in cylindrical vessels and fluids of Prandtl numbers near unity (aqueous solutions and gases), and the data are given. (D.L.C.)

17964 NP-8798
Massachusetts Inst. of Tech., Cambridge. Div. of Sponsored Research.
ENTRANCE EFFECTS IN A DEVELOPING SLUG FLOW. Technical Report No. 18. Raphael Moissis and Peter Griffith. June 1960. 88p. DSR Project No. 7-7673. Contract Nonr 1841(39).

The kinetics of a Taylor bubble, as it rises behind a series of other bubbles in a gas-liquid slug flow, were determined. The rise velocity of a bubble is expressed as a function of separation distance from the bubble ahead of it. Using this information, the pattern of development of bubbles which initially enter a tube at regular intervals was determined by means of finite difference calculations. The density and, to a first approximation the pressure drop, of the developing flow are then calculated from continuity considerations. The density distribution in the entrance region is found to be a function of flow rates of the two phases, of distance from the inlet, and of initial bubble size. Density calculated by the present theory is compared with experimental measurements by the present and other investigators. Theory and experiments are generally in good agreement. (auth)

17965 OOR-407.52
Maryland. Univ., College Park.
FUNDAMENTAL RESEARCH IN APPLIED MATHEMATICS. THE EFFECT OF AN ALIGNED MAGNETIC FIELD ON OSEEN FLOW OF A CONDUCTING FLUID. Interim Technical Report No. 43. G. S. S. Ludford. Nov. 1959. 12p. DA Project No. 5B99-01-004. Contract DA-36-034-ORD-1486. (AD-230150).

The slow flow of an incompressible, viscous, electrically conducting fluid past a sphere which is assumed to have the same magnetic permeability as the fluid is analyzed. The applied magnetic field is uniform but weak and is directed in the free-stream direction. The disturbance of the magnetic field and the fluid inertia are taken into account by using an Oseen-type approximation in which second-order terms in the disturbance quantities are neglected in the equations of motion. (J.R.D.)

17966 SCR-166
Vidya, Inc., Palo Alto, Calif.
STUDY OF REAL GAS AND HEAT TRANSFER EFFECTS ON THE DESIGN OF HOTSHOT WIND TUNNELS. Jackson R. Stalder, Morris W. Rubesin, and David K. Eberly. Mar. 1960. 79p. For Sandia Corp. OTS.

A study of heat transfer in the arc chamber and converging section of the nozzle of a "hotshot" wind tunnel was conducted to determine the effects of heat transfer on the performance of this type of wind tunnel at initial arc-chamber pressures from 100 to 6800 atm and temperatures from 4000 to 14,000°K. Radiation from the hot gas was found to be governed by black-body emission laws for pressures above 100 atm at the temperatures considered. Convection to the throat was evaluated, and it was found that a method developed by Sibulkin for turbulent heat transfer at nozzle throats gives the best estimate of convective heat transfer. Tungsten, copper, and beryllium throat sections were considered. Preliminary evaluations of these materials indicated that tungsten

would be the most durable, followed by copper and beryllium in order of relative durability. The thermal response of tungsten throats with diameters of 0.02, 0.10, and 0.30 inch was evaluated, assuming steady flow at the throat for the entire range of arc-chamber conditions. The time for a 10% loss of arc-chamber enthalpy was estimated using approximate integrals of the mass-balance and energy-balance equations for the arc chamber. The results of this investigation show that the time available for steady test-section flow in the "hotshot" wind tunnel is governed by melting of the nozzle throat at initial arc-chamber pressures approaching 6800 atm. At pressures near 100 atm, radiation to the arc-chamber walls limits the time for steady test-section flow. Transpiration cooling of the throat was found to increase the time to melt the throat. Cooling by injection through slots has a smaller effect than distributed transpiration, but is probably not limited by the empirical stability criterion. However, the possible benefits attainable by slot cooling are cancelled by the effects of radiation to the arc-chamber walls. The maximum time to melt the nozzle throat was found to be limited by gaseous radiation. At pressures approaching 100 atm it was found that the time for steady flow in the test section is governed by radiation to the walls of the arc chamber. Film cooling was found to be of negligible benefit as a means of reducing radiative heat transfer. (auth)

17967

CALCULATIONS OF HEAT TRANSFER FROM SATURATED STEAM TO A CIRCULATING LIQUID UNDER CONDITIONS OF FLOW. Li-ch'un Yuan. Hua Hsüeh Shih Chieh 13, 214-17(1958). (Translated from Referat. Zhur. Khim. No. 23, 1959, abstract No. 82510).

The following equation was derived: $[1 + KF/(N2Gc)]W\ln[(T-t_1)/(T-t_2)] = KF\tau/N$, where t_1 and t_2 are initial and final temperatures of liquid in degrees, T is temperature of steam, K is heat transfer coefficient in kcal/m²/hr/degree, F is heat transfer surface area in m², W is quantity of liquid in a system in kg, G is liquid circulation rate in kg/hr, C is specific heat of the liquid in kcal/kg, τ is duration of heating in hours, $N = A(e^A + 1)/(e^A - 1)$, and $A = KF/(Gc)$. Proposed are analytical and graphical methods for the determination of F or τ values. It was established that changes in K and F greatly affect the process only when $A < 1$; when $A > 4.5$ the above changes have practically no effect on the process. The effect of G increases with an increased value of A.

Instrumentation

17968 AEEW-R-26

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England.

A FISSION CHAMBER FOR OPERATION AT 850°C. D. Barnes, R. C. Hollick, and F. Wade. Feb. 1960. 13p. BIS.

A fission chamber was developed for operation at 850°C in the Zenith Reactor core. Design, performance, and techniques are described. (W.D.M.)

17969 AERE-M-643

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A COMPACT MULTIPLE-STIRRING APPARATUS. W. H. Thornett. May 1960. 6p. BIS.

A compact multiple-stirring apparatus was developed which allowed six samples to be stirred simultaneously. Although developed specifically for bio-assay work, the stirrer can be used for any routine analytical procedure requiring batch stirring. Since the apparatus was intended for use in a normal laboratory fume cupboard, aluminum was chosen for the panelwork and stainless steel for all other exposed parts. (M.C.G.)

17970 CERN-60-14

European Organization for Nuclear Research, Geneva.

DIGITISED PROTRACTORS FOR THE MEASUREMENT OF TRACK CHAMBER PHOTOGRAPHS. G. R. Macleod. Mar. 30, 1960. 29p.

Instruments are described for rapid measurement of nuclear track chamber photographs. The instruments measure angular coordinates with respect to fiducial marks on the photograph by means of a digitized protractor. Two instruments for photos without magnetic fields and one for curved tracks have been developed. Operation and some of the results obtained are described. (W.D.M.)

17971 CR-27

Minnesota. Univ., Minneapolis. School of Physics.

STANDARDIZATION OF IONIZATION CHAMBERS. R. A. Hoffman. Mar. 1960. 45p.

The standardization of ionization chambers which were employed in measuring cosmic radiation is described. Measurement of the charge per pulse is discussed relative to calibration of the electrometer amplifier and the condenser. Calibration of the condenser by the pulse jump, pulse decay, and constant current methods is described. Calibration of a continuous current chamber is described. Calibration of the chambers to a normalized charge/pulse and for a normalized ionization rate is discussed. (C.J.G.)

17972 CRRD-920

Atomic Energy of Canada Ltd., Chalk River, Ont.

A GAMMA SURVEY METER USING A PLASTIC SCINTILLATOR. A. R. Jones. May 1960. 13p.

The design is described of a survey meter using a plastic scintillator and photomultiplier. The circuit consists of a high-voltage supply, a multiplier tube and associated components, and a direct current amplifier. The circuit and an engineering prototype of the survey meter are illustrated. The performance of the instrument is discussed. (C.H.)

17973 HW-51032

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RECIRCULATING GAS LOOP RUPTURE MONITORING. D. C. Pound. June 20, 1957. Decl. June 10, 1960. 11p. Contract W-31-109-Eng-52. OTS.

A brief consideration is made of the problem of fuel element rupture detection in a closed loop recirculating gas cooled system. Two methods, delayed neutron and total gamma, are presented. The calculated sensitivities are of the order of 1×10^{-6} gms of U^{235} per second. The delayed neutron system offers a rapidly stabilized signal with some complexity of the system. The gamma system can be quite simple but it cannot equal the delayed neutron system sensitivity at minimum signal levels until about 13 minutes after the rupture. The optimum solution would be to use both systems to provide automatic confirmation of indications. (auth)

17974 IDO-16608

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

LINE VOLTAGE AND NOISE MONITOR. T. J. Boland. June 2, 1960. 20p. Contract AT(10-1)-205. OTS.

A line monitor is described which provides a means of correlating spurious instrument response with power line disturbances. It can serve as an expanded scale recording voltmeter for alternating currents and as a momentary power outage indicator. (auth)

17975 KAPL-M-GDH-3

Knolls Atomic Power Lab., Schenectady, N. Y.

METHOD OF CALCULATING EFFECTIVE CUTOFF ENERGIES FOR FILTERS USED WITH "1/v" DETECTORS. G. D. Hickman and W. B. Leng. May 10, 1960. 25p. Contract W-31-109-Eng-52. OTS.

A study was undertaken to construct computer programs to be used for the calculation of effective cutoff energies for filters which are employed with 1/v detectors. Two IBM-704 programs, "GQF-3" and "GQF-2," were prepared for this purpose. The first program is for isotropic flux while the latter is for beam flux. Both the filter and detector foils are assumed to be thin and flat, thereby neglecting edge effects. The absorption rate in the detector foil in "GQF-3" was integrated over energy, thickness of detector foil, and angle of neutron incidence. In "GQF-2," the neutrons are restricted to a beam flux, therefore eliminating the integration over angle. The spectrum which is used in these calculations is assumed to consist of a Maxwellian plus a 1/E flux which goes to zero (sharply) at 5 times the Maxwellian characteristic energy E_m. The integrations were performed by Gaussian Quadratures, and a fairly extensive list of Gaussian factors is included. (auth)

17976 NAA-SR-Memo-4617

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

CALCULATED SENSITIVITY OF A CIRCULATING URANIUM HEXAFLUORIDE CONTINUOUS NEUTRON FLUX MONITOR. J. C. McKinley. Jan. 14, 1960. 8p. OTS.

The sensitivity of a circulating uranium hexafluoride continuous neutron flux monitor was calculated in terms of counts per second from the delayed neutron counting tubes as a function of reactor flux. (C.J.G.)

17977 PGR-100(W)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.

ANALYTICAL METHOD FOR THE DETERMINATION OF BETA-ACTIVITY (TRANSMITTED THROUGH A TOTAL ABSORBER THICKNESS 5 mg Al/sq cm) IN PLANT SOLUTIONS CONTAINING PLUTONIUM. May 1960. 6p.

A measured portion of the sample is evaporated to dryness on a stainless steel counting tray. The β activity of the residue is measured using standard G-M equipment with a thin end-window counting tube; the equipment is calibrated against standard strontium-90/yttrium-90 sources in equilibrium, prepared from solutions of known strontium-90 content. A correction is made to account for the amount of plutonium present and the corrected activity is expressed as dpm strontium-90/yttrium-90. (auth)

17978 RIB-44

David Sarnoff Research Center, Princeton, N. J.

DEVELOPMENT OF HIGH SPEED ELECTRON ACCELERATOR STRUCTURES. Interim Report No. 11 [for] February 1, 1960—April 30, 1960. J. A. Baicker, T. S. Chen, and A. H. Sommer. 24p. Contract AT(30-1)-1958. OTS.

The investigation and preliminary development of a traveling-wave output structure for a high-speed photomultiplier are described. This investigation was begun to increase the efficiency with which the signal in the photomultiplier beam pulse is converted into a voltage pulse at the output. The requirements for the device necessary to amplify the output signal from the photomultiplier are explained. (B.O.G.)

17979 SCR-206

Sandia Corp., Albuquerque, N. Mex.

DETERMINATION OF CERTIFICATION INTERVALS FOR STANDARD RESISTORS AND PRECISION POTENTIOMETERS. Leo H. Bressan. June 1960. 16p. OTS.

Presented at Conference on Electronics Standards and Measurements, Boulder Laboratories of the National Bureau of Standards, Boulder, Colorado, June 23, 1960.

The long-term stability was studied for the standard resistors and precision potentiometers (with accessory volt boxes and shunts) used in the standards program for the AEC Atomic Weapons program. The data analyzed were obtained from two sources: annual certification tests of the equipment made by the Electrical Standards Division of Sandia Corporation and semiannual crosschecks made by the laboratories using the equipment. The study was made to determine whether the one-year interval between certifications could be extended. It was concluded that an extension to two years was justified, provided that semiannual crosschecks, including careful visual inspection, are continued. (auth)

17980 SCTM-86-60(52)

Sandia Corp., Albuquerque, N. Mex.

THERMOELECTRIC CELLS AS AN AUXILIARY POWER SUPPLY IN SATELLITES AND SPACE MISSILES. H. G. Laursen. Apr. 1960. 10p. OTS.

Thermoelectric cells, as an auxiliary power supply in satellites and space missiles, were studied. Neutralizing the space charge at high current densities, reducing the evaporation rate of the cathode, maintaining the work function of the anode at a low value, minimizing all heat and electrical losses, and converting the cell output to the voltage and current desired were the problems investigated. The resonance ionization method showed the most promise in neutralizing the space charge. Radiation from the cathode was minimized by using highly polished reflectors and making the anode a highly reflecting surface. Progress was also made toward solution of the other problems. (M.C.G.)

17981 UCRL-9089

California. Univ., Berkeley. Lawrence Radiation Lab.

MICROSCOPE EQUIPMENT FOR NUCLEAR EMULSION ANALYSIS. James C. Hodges. Feb. 1960. 132p. Contract W-7405-eng-48. OTS.

A comprehensive survey of microscope optics and mechanical equipment most suitable for observing and measuring nuclear tracks in photographic emulsions is given. The problems of adapting commercial instruments and of building special microscopes to handle large emulsion sizes are discussed. Considerable attention is given to the design and fabrication of mechanical stages. Included are extended-travel scanning and measuring stages for attaching to conventional microscope stands, as well as more massive stage types for building into custom equipment. Special aids toward increased efficiency in handling large volumes of emulsion are discussed with emphasis on the selection and installation of digitizing equipment. (auth)

17982 WCAP-6042

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

NUCLEAR MATERIALS CONTROL SYSTEM (NMCS) PHASE II—FIELD TESTING OF THE FUEL ASSAY SCANNER. F. J. Arsenault. June 22, 1960. 35p. Contract AT(30-1)-2176, Task I. OTS.

A fuel assay scanner designed and constructed for non-destructive assay of MTR and ETR type fuel elements is described. The instrument was designed to assay uranium-235 by measuring the natural gamma-ray emission, and to measure uranium-235 plus poison content by a thermal neutron transmission technique. A combination of the two measurements allows calculation of the poison content. Uranium-235 content may currently be assayed with the Scanner to ±0.54%; the boron content may be measured to ±0.1 grams. Measurements on the aluminum content of the elements are expected to improve the accuracy to ±0.21% for the uranium-235, and ±0.06 grams for the boron. The Scanner is currently in operational use at the MTR-ETR site. (auth)

17983 NP-tr-456

AN RC AMPLIFIER WITH A BANDWIDTH OF 60 Mc/s. K. J. Schmidt-Tiedemann. Translated by E. Franklin (U.K.A.E.A. Atomic Energy Research Establishment) from Elektron. Rundschau 12, 414-16(1958). 11p. JCL.

An amplifier circuit is described in which the limit set by stray capacitances in the RC amplifier is overcome by use of the cathode follower. The transfer function for this circuit is derived, and optimum design is discussed. The properties and performance of the circuit are illustrated by an example of application. (J.R.D.)

17984 SCL-T-304

THE ACCURACY OF THE DETERMINATION OF ANGLES WITH THE AID OF AN AZIMUTHAL APPARATUS WITH INCLINED SEISMOGRAPHS. (O Tochnosti Opredeleniia Uglov s Pomoshch'u Azimual'noi Ustanovki s Naklonnymi Seismografami). V. N. Gaiskii. Translated by Marcel I. Weinreich (Sandia Corp.) from Trudy Inst. Seismol., Akad. Nauk Tadzhik. S.S.R. 71, 39-45(1957). 10p. JCL or LC.

17985

RADIATION DETECTION INSTRUMENTS WITH TRANSISTORS. Lorenz Beug and Günter Rudack. A E G Mitt. 50, 86-90(1960) Jan.-Feb. (In German)

A radiation detection instrument with a trigger counter tube is described. The counting tube, high-voltage source, and pulse former with integration elements are in a steel tube. The unit operates with 8 v direct voltage which is produced by a separate power supply. Only direct current goes over the instrument leads so that a large circuit length is possible. The instrument is supplied only with transistors. (tr-auth)

17986

ON A SIMPLE INSTRUMENT FOR MEASUREMENT OF MAGNETIC FIELDS BY NUCLEAR MAGNETIC RESONANCE. G. v. Foerster (Universität, Giessen, Ger.). Atomkernenergie 5, 230-1(1960) June. (In German)

A simple nuclear magnetic resonance (NMR) device for precisely measuring static magnetic fields is described. It is used between 4 and 40 Mc, corresponding to a magnetic field range of 1000 to 10,000 gauss. This device has a high sensitivity over the full range and gives high NMR-signals. Since it is easily operated, it can be used for both laboratory and training. For magnetic field measuring a phase-sensitive detector is added. (auth)

17987

A SIMPLE METHOD FOR THE IN VIVO DISCRIMINATION OF CHROMIUM 51 AND IRON 59. Ann Crook and L. Szur (Hammersmith Hospital, London). Brit. J. Radiol. 33, 447-50(1960) July.

The use of a lead filter provides a simple, inexpensive method for in vivo simultaneous counting of chromium-51 and iron-59. Details of the measuring technique and its advantages over other methods are discussed. (C.H.)

17988

AN AUTOMATIC CLINICAL SCINTILLATION SCANNER FOR LARGE AREAS. D. Hughes, H. J. Hodt, S. P. Newberry, and R. C. Sbresni (Royal Marsden Hospital, London and Royal Cancer Hospital, London). Brit. J. Radiol. 33, 462-5(1960) July.

The design and performance are described of an automatic clinical scintillation scanner for large areas. (C.H.)

17989

TEMPERATURE DEPENDENCE OF CERIC-CEROUS GAMMA-RAY DOSIMETER. Hiroshi Hotta and Kazuo Shimada (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan 33, 114-5(1960) Jan. (In English)

The temperature dependence of the radioinduced yields of cerous ion in 0.8 N H_2SO_4 solutions of ceric sulfate was studied by irradiating solutions for 1 or 2 hours in a water thermostat at temperatures between 20 and 90°C. The dose rates were between 7×10^4 and 6×10^6 r/hr, and the cerous ion yield was determined by the change in absorbance at 314 mμ. Data for two dose rates, 5.6×10^5 and 1.7×10^6 r/hr, are plotted on a log absorbance vs 1/T graph, and a small but definite temperature dependence is observed. (D.L.C.)

17990

DEUTERIUM CONTENT OF THE U. S. NATIONAL BUREAU OF STANDARDS ISOTOPE REFERENCE SAMPLES. Yoshio Horibe and Mituko Kobayakawa (Tokyo Metropolitan Univ.). Bull. Chem. Soc. Japan 33, 116-17(1960) Jan. (In English)

In order to provide an absolute standard for deuterium studies which used Tokyo tap water as a working standard, the tap water was analyzed for D with a mass spectrometer and then the U. S. National Bureau of Standards' reference D_2O samples NBS-1 and NBS-1A were analyzed with tap water as standard. The relative enrichment of NBS-1A to NBS-1 was found to be -14.13 ± 0.23, in good agreement with Craig's value of -14.25 ± 0.25. (D.L.C.)

17991

DISINTEGRATION-RATE DETERMINATION BY 4π-COUNTING. PART V. FURTHER STUDIES ON ABSORPTION AND SCATTERING OF β-RADIATION. L. Yaffe and J. B. Fishman (McGill Univ., Montreal). Can. J. Chem. 38, 1113-21(1960) July.

The study of absorption and scattering of β-radiation in a 4π-counter was extended to greater source-mount thickness. As the thickness is increased, the backscattering curves assume the juxtaposition obtained in $<2\pi$ geometrical systems. The saturation backscattering value S is attained at a mass approximately one-fifth that of the range of the β-radiation. The relationship $S = 0.070 \log_{10} E_{max} + 0.142$, where E_{max} is the maximum energy of the β-radiation, is obeyed over the range studied. The phenomenon of coincident discharges, while adequately explained by Pate and Yaffe as caused by wall- and gas-scattering if thin film source mounts are used, cannot completely account for the results with thicker films. Other phenomena, such as bremsstrahlung and secondary electron production, begin to play a role. (auth)

17992

BATTERY POWERED CONVERTER RUNS MULTIPLIER PHOTOTUBE. Richard P. Rufer (Univ. of California, Livermore). Electronics 33, No. 28, 51(1960) July 8.

For the operation of a multiplier phototube in the absence of power, a string of Cockcroft-Walton voltage doublers powered by a battery was devised. An advantage of this battery converter is its lack of quiescent power

loss, giving a more constant dynode voltage. The design of the flip-flop circuit in the power supply is conventional except for its regulation which is done by a magnet-coupled multivibrator. Solar cells can be used to operate the tube. (D.L.C.)

17993

A UNIVERSAL TEN-CHANNEL TIME ANALYZER. Gy. Iványi and F. Szlávik (Zentralforschungsinstitut für Physik, Budapest). Exptl. Tech. Physik 8, 25-34(1960). (In German)

A ten-channel time analyzer which can be differentiated into an integral and a differential analyzer is described in detail. The principal components of the analyzer are discussed, and their circuits are presented. (J.S.R.)

17994

THE CALCULATION OF ELECTROSTATIC ELECTRON-GUN PERFORMANCE. M. R. Barber (Naval Research Labs., Auckland, N. Z.) and K. F. Sander (Cambridge Univ., Eng.). J. Electronics and Control (1), 7, 465-81 (1959) Dec. (In English)

An automatic electron trajectory tracer was used to analyze four different high current density electron guns operated electrostatically. Trojectory plots are given. (auth)

17995

EXACT ELECTRODES FOR THE FORMATION OF A CURVED SPACE-CHARGE BEAM. [PART] II. R. J. Lomax (Cambridge Univ., Eng.). J. Electronics and Control (1), 7, 482-90(1959) Dec.

The analytical method of determining Pierce-electrode shapes for curved space-charge beams, given in an earlier paper, is extended by removing the requirement that explicit expressions are needed for the potential and field distributions along the edge of the beam. The Walker-Ivey solution for flow between inclined plane electrodes is used to demonstrate the technique when the potential and field are given only by differential equations which cannot be solved in closed form. (auth)

17996

USE OF A LIQUID SCINTILLATOR COUNTER FOR BETA PARTICLES. T. B. Ryves (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr. 37, 201-3(1960) June.

A simple counting technique is described for absolute counting of beta particles using a 4π liquid scintillator technique. The radioactive sample is deposited on a thin backing film of transparent material, which is then immersed in the liquid scintillator. It was found that for samples with a maximum beta particle energy greater than 0.7 Mev, the detection efficiency was close to 100%, comparing favorably with other methods of absolute counting. (auth)

17997

A RADIATION WARNING HAND APPARATUS WITH A SMALL LOUDSPEAKER IN A TRANSISTOR CIRCUIT. P. Kunze and H. Mittenentzwei. Kernenergie 1, 337-8 (1958) May. (In German)

After a brief survey of portable radiation warning devices, a description is given of a transistor instrument with a loudspeaker. The power source is a small 3-v dry cell. The β-counting tube extends from the housing, and the battery is in the handgrip. The current requirement is 45 ma. A transverter supplies the counting-tube potential of 350 to 450 v. (T.R.H.)

17998

COUNTER WITH DECREASED DEPENDENCE ON SENSITIVITY TO ENERGY OF γ QUANTA. V. N. Sakharov (Sacharov). Kernenergie 1, 391-2(1958) May. (In German)

Counting rate versus gamma intensity was studied for Geiger tubes with jackets of Cu, Al, and a special combination material. The special tube has a 30 μ steel wall 103 mm long and 17.5 mm diam. The radiations from Hg^{197}, Ce^{141}, Hg^{203}, Cr^{51}, Au^{198}, Cu^{64}, Cs^{134}, Zn^{65}, Co^{60}, and Na^{24} were used. The special counter 400 SBM-2 was least energy sensitive and had the best characteristics. Other experimental types were tested but with poorer results. (T.R.H.)

17999

AN IRON-FREE β-SPECTROMETER WITH DOUBLE FOCUSING. Kernenergie 1, 422(1958) May. (In German)

A Magnetic β spectrometer with double focusing of the electron beam at a central angle of $\pi\sqrt{2}$ in the magnetic field of an iron-free coil system was developed and tested. The magnetic field followed that calculated by P. Pavinskii with an accuracy of 0.2%. The spectrometer analyzes electrons up to 0.3 Mev. Its dimensions are 400 mm diam., 280 mm height, and 40 kg weight. (T.R.H.)

18000

STUDY OF THE MODE OF OPERATION OF GAS DISCHARGE COUNTERS WITH CONTROLLING PULSES. V. V. Vishnyakov (Višnjakov) and A. A. Tyapkin (Tjapkin). Kernenergie 1, 571-8(1958) July-Aug. (In German)

The counting errors of gas discharge counters because of deadtime are eliminated by pulse operation. In connection with this, experiments with accelerators indicate the possibility of a hodographic system with pulse-operated counters. The counting characteristics, efficiency, and resolution of self-quenched counting tubes of series-connected manufacture were studied in pulse operation. It was found that in the case of short-time input (pulses of $\sim 10^{-6}$ sec) the counting tube will work at an overvoltage up to 2 kv. In this case, the necessity for amplifying the counting-tube pulse and subtracting the coincidence from the operating pulse enters into the hodographic channel. Each channel has connected with it a load resistance and a neon signal lamp. The main improvement in comparison with ordinary hodographs as well as with present operation of counting tubes with pulse input lies in the use of such a system for cosmic-ray studies. (tr-auth)

18001

CHEMICAL DOSIMETRY OF γ AND X RADIATION. D. Bertram. Kernenergie 1, 697-708(1958) Sept. (In German)

A short compilation of the methods of chemical dosimetry of γ and x radiation is presented. They are described according to a classification as to use of aqueous solutions, organic materials, and organic solutions, as well as solid and gaseous dosimetry situations. (tr-auth)

18002

USE OF LIQUID NUCLEAR EMULSION K-2 FOR MICRO-AUTORADIOGRAPHY. W. Malz (Deutsche Akademie der Wissenschaften, Berlin-Buch). Kernenergie 1, 813-16 (1958) Oct. (In German)

A method for making microautoradiographs with liquid K-2 nuclear emulsion by VEB Agfa-Wolfen is described. The emulsion is suitable for detection of α and β particles up to the energy of P^{32}. Using microautoradiographic representation, α radiators and the physiologically important P^{32} and S^{35} can be pointed out. On the basis of the relatively great simplicity and safety of the method, it is well suited to routine investigations. (tr-auth)

18003

THE DRESDEN MOLECULAR SPECTROGRAPH—A NEW

KIND OF PRECISION MASS SPECTROGRAPH FOR NEGATIVE HIGH MOLECULAR WEIGHT IONS. M. von Ardenne (Forschungsinstitut Manfred von Ardenne, Dresden-Weisser Hirsch, Ger.). Kernenergie 1, 1029-44(1958) Dec. (In German)

A precision mass spectrograph for negative high-molecular-weight ions is described. By using negative ions from an electron deposition ion source with a magnetically compressed low-voltage gas discharge, the probability of molecular cleavage in the substance being analyzed is sufficiently reduced. Owing to the high yield of the electron deposition ion source developed, it is now possible to obtain molecular spectra of multi-atomic hydrocarbons which were not previously observable because of their low intensity. Also owing to the high yield ion producer, the Dresden Molecular Mass Spectrograph, in spite of the simple ion-optical structure, has a resolving power of A > 1500. It permits visual consideration of strongly magnified molecular mass lines on the fluorescent screen of an ion optical lens converter. A method is shown for obtaining the molecular spectra of paraffins and higher alcohols which characterizes the possibilities opened up and the performance of this apparatus. (tr-auth)

18004

GERMAN NEUTRON DIFFRACTION APPARATUS. Nuclear Energy 14, 269-71(1960) June.

The functions and design of an apparatus are described which permits the examination of solid materials by observing the intensity of scattered neutrons. Principal features of this design are: variable wave length; crystal accessibility and rotatability; space for accessory equipment; rotation of counter and specimen; changes while reactor is operable; and tolerances (B.O.G.)

18005

EFFECT OF FINITE SIZE OF IONIZATION CHAMBERS ON MEASUREMENTS OF SMALL PHOTON SOURCES. S. Kondo and M. L. Randolph (Oak Ridge National Lab., Tenn.). Radiation Research 13, 37-60(1960) July.

The surface integral corrections developed and those obtained from the generalized Spiers formulas both account for the experimental deviations of ion chamber readings from the inverse-square law with a precision better than ±3% under very severe conditions. They are satisfactory improvements over the volume integral corrections. Although the theoretical basis for the correction factors is more rigorous than that for Spiers' work, conclusive experimental demonstration of a choice between the theories requires further, more-precise measurements. The simple, albeit tedious, theory resembles a thermodynamic theory that satisfactorily describes the over-all behavior of a system but is inadequate to describe the detailed mechanism, which in this case is secondary-electron behavior. (auth)

18006

MEASUREMENT OF THE DOSE IN SMALL TISSUE VOLUMES SURROUNDING "POINT" SOURCES OF RADIOISOTOPES. Patricia McClement Failla and Gioacchino Failla (Columbia Univ., New York). Radiation Research 13, 61-91(1960) July.

Problems associated with the determination of the radiation dose received by a cell, or small tissue volume, from radioactive material inside the cell, or tissue itself, are given. Procedures are described which were used to determine the integral dose in a tiny mass of protoplasm. Since it was impossible to place an ionization chamber inside the cell, the cell and its surrounding medium were expanded to a much larger size by using a tissue-equivalent gas to represent the cell and medium. All linear dimensions were enlarged in the ratio of the density of tissue and that of the gas. Results, uncertainties, and principal sources of error are discussed. Schematic sketches are included of two wall-less ionization chambers which were developed for the measurements. The results for each isotope in absolute units are presented for spherical tissue volumes with radii up to about 200 μ in both integral and differential forms. Some of the biological applications of the results of the investigation are indicated. (C.H.)

18007

A SCINTILLATION COUNTER TECHNIQUE FOR THE X-RAY DETERMINATION OF BONE MINERAL CONTENT. Edward H. Mayer, Herbert G. Trostle, Eugene Ackerman, Harald Schraer, and O. Dayle Sittler (Pennsylvania State Univ., University Park). Radiation Research 13, 156-67(1960) July.

The use of a scintillation counter as an x-ray detector for bone density measurement was investigated experimentally. It was shown that the accuracy of bone density measurement attainable with the scintillation counter technique is as good as that attainable with the older x-ray film technique. Since the scintillation counter technique eliminates the film as a source of error and can reduce scattering error by means of a collimated beam, it is possible that this technique may be made more accurate than the film technique. X-ray film, on the other hand, has the advantage of providing a more permanent record of the bone and clearly shows the points on the bone where the trace path is located. (auth)

18008

METHOD OF BUTT WELDING SMALL THERMOCOUPLES 0.001 to 0.010 INCH IN DIAMETER. Clifford M. Stover (Sandia Corp., Albuquerque, N. Mex.). Rev. Sci. Instr. 31, 605-8(1960) June.

A method of butt welding thermocouples 0.001 to 0.010 in. in diameter is described. The thermocouple wires are positioned in a micro-manipulator, and a controlled welding pulse is applied to them. This welding method provides uniform upset welds through a simple production technique. (auth)

18009

PERMEABILITY AND DIFFUSIVITY OF HYDROGEN THROUGH A PALLADIUM TUBE. O. M. Katz and E. A. Gulbransen (Westinghouse Research Labs., Pittsburgh). Rev. Sci. Instr. 31, 615-17(1960) June.

A palladium diffusion tube which supplied high purity hydrogen was constructed for use in a high vacuum glass system. Temperatures of 213 to 379°C and back pressures from 1 to 2 atm H_2 were used. In this range the permeability was proportional to the square root of pressure and an exponential function of reciprocal temperature. The tube had a long life if kept above 150°C while exposed to the gas. Diffusion coefficients obtained from the permeability experiments were in very good agreement with previous results. The equation for diffusion was $D_H^{Pd} = 4.3_1 \times 10^{-3} e^{-5660/RT}$. The large amounts of hydrogen obtained were reproducible to ±2% of the mean. (auth)

18010

DETECTION AND CORRECTION OF NONLINEARITY IN X-RAY PROPORTIONAL COUNTERS. M. A. Short (Pennsylvania State Univ., University Park). Rev. Sci. Instr. 31, 618-20(1960) June.

A simple procedure was described for the detection and correction of nonlinearity in x-ray proportional counters. This procedure was shown to be superior to the simple version of the multiple foil method. Under typical working

conditions a General Electric 1 SPG counter was found to be linear (to within 0.03%) up to 4000 counts/sec. (auth)

18011

EFFICIENT NEUTRON DETECTOR WITH A STABLE ENERGY THRESHOLD. Douglas Miller and Russell K. Hobbie (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instr. 31, 621-3(1960) June.

The principle of a range telescope was iterated to achieve a neutron detector with 2% efficiency at 125 Mev. The energy threshold was variable, yet its stability was high enough for precise asymmetry measurements. The logic of the counter introduced several economies in instrumentation. (auth)

18012

TRANSISTORIZED PRECISION RATEMETER. G. Giannelli and V. Mandl (Centro Studi Nucleari, Ispra, Italy). Rev. Sci. Instr. 31, 623-5(1960) June.

A linear ratemeter based on a special circuit with a saturated-core blocking oscillator was described. This circuit fed a capacitance with a calibrated quantity of electric charge for every input pulse. The instrument was characterized by an absolute zero stability, a good linearity, and independence from temperature. (auth)

18013

ABSORPTION OF GAMMA RADIATION IN NaI WELL CRYSTALS. M. H. Wächter, W. H. Ellett, and G. L. Brownell (Massachusetts General Hospital, Boston). Rev. Sci. Instr. 31, 626-30(1960) June.

The results of Monte Carlo calculations on the detection and total absorption peak efficiencies of spherical NaI crystals are presented. A method of applying these data to cylindrical well crystals of arbitrary size and well geometry is described and the results are compared with experimental data. The Monte Carlo computations cover the gamma-ray energy range from 200 kev to 2 Mev and crystal radii from 1.5 to 12.0 cm. Histograms are presented of the number of Compton scattering events which a 0.662-Mev gamma ray undergoes in crystals of different sizes. (auth)

18014

WORKABLE MAGNETIC SHIM TO CORRECT SECOND-ORDER ABERRATION IN A MASS SPECTROMETER. Silvio J. Balestrini (Los Alamos Scientific Lab., N. Mex.) and Frederick A. White (General Electric Co., Schenectady, N. Y.). Rev. Sci. Instr. 31, 633-6(1960) June.

A simple magnetic shim was developed and tested to obtain second-order focusing in an existing conventional mass spectrometer of the magnetic sector type. An easily applied formula is developed for its fabrication from a sheet of thin magnetic material, and a practical method for its alignment is discussed. The improved second-order focusing obtained is demonstrated by displaying the spectrometer signal directly on an oscilloscope. The property of the shim to correct defocusing due to spectrometer misalignment is demonstrated. (auth)

18015

A PLANE-CRYSTAL AND BENT-CRYSTAL HIGH RESOLVING-POWER NEUTRON SPECTROMETER. D. Bally, S. Todireanu, E. Tarină, and I. Olteanu (Inst. of Atomic Physics, Bucharest). Rev. Sci. Instr. 31, 640-6(1960) June.

The resolving function and the shape of the rocking curves are calculated for plane-crystal neutron spectrometers, taking into account the effect of total reflection from the collimator walk. The features of crystal-type neutron spectrometers are described for the plane-crystal and bent-crystal variants, and results obtained with such a spectrometer are presented. When using a calcite crystal, the resolving power of the instrument is 0.53 μsec/m. In this case, the energy range extended to 5.5 ev. Results obtained with a bent-quartz crystal are presented. (auth)

18016

NEW TYPE OF LIQUID HELIUM DEWAR SYSTEM. R. A. Levy and M. J. Zucker (Hughes Products, Newport Beach, Calif.). Rev. Sci. Instr. 31, 656(1960) June.

A new type of Dewar system for small volumes of liquid helium was successfully used in runs lasting up to 8 hr. The region of restricted volume of the outer Dewar containing liquid nitrogen was replaced by a curtain of liquid nitrogen flowing over the outer surface of the inner Dewar. (M.C.G.)

18017

DEWAR-JACKETED NMR INSERT. Cafiero Franconi and Gideon Fraenkel (California Inst. of Tech., Pasadena). Rev. Sci. Instr. 31, 657(1960) June.

A Dewar-jacketed insert was developed for use in high-resolution nuclear magnetic resonance spectroscopy at temperatures between −100 and +200°C. The insert fits the standard Varian probe, operates at a low pressure differential, and can be used for several fixed frequencies by changing only the insert tubes. (M.C.G.)

18018

LIGHT-COUPLED MULTIVIBRATOR. L. Cathey (E. I. du Pont de Nemours & Co., Aiken, S. C.). Rev. Sci. Instr. 31, 661-2(1960) June.

A simple light-coupled multivibrator circuit was assembled using a 6977 triode indicator lamp to illuminate the cathode of a photomultiplier. The output of this circuit could be used to drive a small speaker or to operate a meter. In a scintillation counter, this circuit eliminated the need for a separate discriminator and amplifier. The instrument had an upper frequency limit of 20 kc and required about one week to achieve stability. (M.C.G.)

18019

SHOCK EXCITATION OF A RADIO FREQUENCY POWER CIRCUIT BY MEANS OF A SATURABLE-CORE REACTOR. W. F. Westendorp and H. Hurwitz, Jr. (General Electric Co., Schenectady, N. Y.). Rev. Sci. Instr. 31, 662-3(1960) June.

A new method for obtaining high-power radiofrequency pulses of only a few microseconds duration was developed. A capacitor bank was discharged through a triggered spark gap in series with a saturable-core reactor, and the peaked voltage wave developed across the reactor was used to shock excite a radiofrequency tank circuit. (M.C.G.)

18020

ANTI-COINCIDENCE CIRCUIT FOR USE IN THE MILLI-MICROSECOND REGION. Richard Madey and David A. Barge (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr. 31, 664-5(1960) June.

An anti-coincidence circuit for use in the millimicrosecond range was attained by modifying a crystal diode coincidence circuit. A fifth diode was added to the original four-fold coincidence circuit in series with the 1-k resistor. The circuit was tested with pulses from five scintillation counters arranged as a telescope in the 80-Mev meson (π^+) beam at the Nevis cyclotron. (M.C.G.)

18021

LIGHT COLLECTION IN LIQUID SCINTILLATOR CELLS. D. O. Cummins, C. F. G. Delaney, and I. R. McAulay (Trinity Coll., Dublin). Sci. Proc. Roy. Dublin Soc., Ser. A 1, 21-6(1960) Mar.

A study was made of light collection in the glass cells

used in liquid scintillation counting. The variation of efficiency of collection over the volume of the cell was investigated for three types of cell—plain glass, glass with an aluminum foil reflector, and glass with a titanium dioxide diffuse reflector. An interesting region of approximately constant efficiency was found in the case of the plain glass cell, and its possible importance in pulse height analysis discussed. (auth)

18022

INTRODUCTION OF ANALYZED GASES INTO THE ION SOURCE OF A MASS SPECTROMETER. M. S. Chupakhin (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim. 15, 155-8(1960) Mar.-Apr. (In Russian)

The effect of isotope fractionation was studied for gas flow through a glass diaphragm placed in the channel of the feeding system. The minimum gas volumes were established, necessary for obtaining peak intensities which enables recording changes in the isotope composition of natural gases. The design of the three-channel feeding system is described permitting the simultaneous comparison of two samples with the standard. (auth)

Materials Testing

18023 K-1393

Oak Ridge Gaseous Diffusion Plant, Tenn.

RESONANT FREQUENCY TESTER: A MACHINE USING MEASUREMENT OF FREQUENCY DECAY FOR QUALITY EVALUATION OF AXIAL FLOW COMPRESSOR BLADES. E. R. Taylor, C. R. Lay, Jr., and C. H. Mahoney. June 30, 1960. 38p. Contract W-7405-eng-26. OTS.

A method employing measurement of decay in natural frequency was developed for rapidly determining the quality of die cast, aluminum alloy, axial flow compressor blades. This method provides a nondestructive, positive means for identifying blades having defects that would impair their performance in axial flow compressors, and can also be used for measuring the endurance strength of the blades. Three machines employing this method were constructed. One of these is designed for routine inspection of compressor blades and completes an inspection in one and one-half to two and one-half minutes, depending on the blade design. This rate of inspection allows a lower labor cost for quality control than is usually obtained by other inspection methods. Another machine is a more versatile laboratory instrument for developmental studies of fatigue and other physical properties of compressor blades and similar cantilever specimens. The third machine combines the features of the two earlier models. (auth)

18024

COMPRESSION TESTING AT CONSTANT TRUE STRAIN RATES. J. E. Hockett (Los Alamos Scientific Lab., N. Mex.). Am. Soc. Testing Materials, Proc. 59, 1309-19(1959).

A cam plastometer was designed and built to test metal specimens in compression over a range of constant true strain rates and temperatures. Commercially pure aluminum specimens were tested at room temperature at three strain rates. Depleted uranium specimens were tested at several strain rates and temperatures. True stress versus true strain curves were calculated and found to fit an equation of the form $\sigma = A(1 - e^{B\epsilon}) + C\epsilon$, where σ is the true stress, ϵ is the true strain, and A, B, and C are parameters. The parameters A and C were found to increase with decreasing temperature and with large increases in strain rate. The parameter B was found to be essentially independent of temperature, but a large increase of strain rate produced an increase in B. The use of the cam plastometer with statistical methods provides an accurate means of investigating the effects of temperature and strain rate on the resistance of specimens to compression. The effects of alloying elements, impurities, grain size, and thermal treatments on the resistance to compression may also be determined by this method. (auth)

18025

THERMAL PROPERTY MEASUREMENTS AT VERY HIGH TEMPERATURES. N. S. Rasor and J. D. McClelland (Atomics International, Canoga Park, Calif.). Rev. Sci. Instr. 31, 595-604(1960) June.

Techniques and apparatus were developed for determining thermal expansion, specific heat, and thermal conductivity to as high as 3650°C. To obtain and measure the temperatures required, a graphite tube furnace, a graphite helix furnace, and a photoelectric pyrometer were developed and constructed. The details of their design and their use for property determinations to the destruction temperatures of a variety of refractory materials were described. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

18026 CF-60-6-37

Oak Ridge National Lab., Tenn.

DETERMINATION OF THORIUM IN ROCK SAMPLES BY GAMMA SPECTROMETRY. S. A. Reynolds. June 7, 1960. 7p. Contract [W-7405-eng-26]. OTS.

An investigation was made of the feasibility of measuring thorium in rock samples by use of scintillation spectrometry facilities available in the ORNL Analytical Chemistry Division. Results of measurement of eleven samples indicate that the method is usable and that agreement with chemical analysis is reasonable. (auth)

18027 HW-57722

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A CLIMATOLOGICAL STUDY OF THE HANFORD AREA. D. E. Jenne and R. E. Kerns. Nov. 30, 1959. 131p. Contract AT(45-1)-1350. OTS.

Meteorological observations in the Hanford Works Area for the period 1945 to 1958 are summarized. Data are presented on surface temperatures, precipitation, wind, barometric pressure, diffusion climatology, psychrometric data, and miscellaneous phenomena. (C.J.G.)

18028 HW-61644

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

TECHNIQUES FOR ESTIMATING THE SPECIFIC RETENTION PROPERTIES OF HANFORD SOILS. William H. Bierschenk. Aug. 20, 1959. 44p. Contract AT(45-1)-1350. OTS.

The specific retention capacity of a soil varies with the period of draining, with the size of the sample, and with soil characteristics such as the average grain size. It is recognized that mechanical analyses permit only a qualitative description of the soil which is useful chiefly for comparison purposes. Data have been obtained which indicate that the natural moisture content of certain Hanford soils in the field may be satisfactorily reproduced by draining a 1 cm thick sample of soil from the same hori-

zon at 1,000 gravities for 1 hour in a centrifuge. This empirical test was applied to samples from geologic horizons having a natural moisture content ranging from <1 to about 18% moisture by volume. The average ratio of the natural field moisture content to that defined after centrifuging saturated samples ranged from 0.82 to 1.06, indicating good reproduction of the natural moisture content by the centrifuge drainage technique. Assuming this moisture content represents equilibrium specific retention after extended drainage, the specific retention capacity of columns of soils beneath 200-West Area was estimated to be roughly 2% volume whereas beneath 200-East Area it was estimated to be less than 1%. Terzaghi's equation ($t_1 = N^2 \bar{t}$), which theoretically relates drainage time and the gravitational force applied to achieve a given drainage was tested. The results averaged about 7% by volume for certain columns of soils beneath 200-West Area and about 3% for 200-East Area for drainage periods of 30 years at one gravity. (auth)

18029 NP-8745
Israel. Water Planning for Israel Ltd., Tel Aviv.
USE OF RADIOISOTOPES IN STUDIES OF GROUNDWATER FLOW. E. Halevy and A. Nir. Apr. 1960. 41p.

Solutions of the problems of groundwater tracing were attempted by the use of tracer techniques. The proper choice of radioisotopes involved considerations of physical and chemical properties, health hazards, and general characteristics of the system. Isotopes considered for use are listed. A detection instrument based on large volume and continuous sampling was used. Preliminary laboratory and field tests were run to determine the suitability of the tracers. Field tests were carried out in carefully selected locations with various isotopes, and the results are given. (M.C.G.)

18030 NYO-7950
Pennsylvania State Univ., University Park. Coll. of Mineral Industries.
AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY AND PALEOBOTANY OF URANIUM-BEARING LIGNITES. May 24, 1960. 14p. Contract AT(30-1)-2000. OTS.

The mineralogy, petrography, and paleobotany of Florida peats were investigated. (C.J.G.)

18031 RME-131
Grand Junction Operations Office. Production Evaluation Div., AEC.
MOBILE AND PORTABLE UNITS FOR GEOCHEMICAL EXPLORATION FOR URANIUM. C. T. Illsley and R. L. Kinnaman. July 1959. 27p. OTS.

Geochemical exploration for uranium ore deposits usually requires prompt delivery of reliable analytical data to the field party. This is true of both hydrogeochemical and soil sampling projects since specific areas must be selected as soon as possible after initial sampling. Prompt and reliable analytical data can most rapidly be obtained with a mobile geochemical laboratory located at a base camp near the area of interest, such as described in this report. Exploration projects which require a field party to be absent from the base camp for long periods of time can include hydrogeochemical sampling if a portable kit is carried into the field. This report describes a portable geochemical kit equipped for extracting uranium from water samples and measuring the pH and conductivity of the water on the spot. Analytical procedures are given for determining the uranium, bicarbonate and sulfate content in waters and lists of the necessary equipment and supplies required for both mobile and portable equipment are presented. (auth)

18032 TEI-753
Geological Survey, Washington, D. C.
GEOLOGIC INVESTIGATIONS IN SUPPORT OF PROJECT CHARIOT IN THE VICINITY OF CAPE THOMPSON, NORTHWESTERN ALASKA—PRELIMINARY REPORT. Reuben Kachadoorian, R. H. Campbell, G. W. Moore, J. Y. Cole, A. H. Lachenbruch, G. W. Greene, D. F. Barnes, R. M. Waller, W. L. Lamar, and M. J. Slaughter. Jan. 1960. 94p., 5 illus. OTS.

The geology of the Chariot test site at Ogotoruk Creek in the vicinity of Cape Thompson, Alaska, is discussed. The material to be excavated for an experimental deep-water excavation consisted chiefly of mudstone, siltstone, and sandstone of the Tiglukpuk formation of Jurassic(?) age. Test holes Able and Baker indicated that the devices will be located entirely in frozen mudstone containing numerous small faults. The fault zones in the mudstone are generally less than 1 foot thick. In Hole Baker, however, there is a 14.1-foot fault zone from 136.2 to 150.3 feet below the surface. During the drilling program in 1959 the walls of the holes slumped into the bottom of the hole when the relatively warm drilling fluid thawed the permafrost in the mudstone. The moisture content of the rocks that underlie the test site is believed to be in the vicinity of 10%. On the basis of preliminary geothermal data the tentative depth of permafrost in Hole Able is at least 800 feet below the surface and at least 1,000 feet in Hole Baker. Seismic measurements in the frozen Tiglukpuk rocks indicate velocities ranging from 11,500 to 14,500 fps and averaging about 13,500 fps. Surface refraction measurements suggest a slight increase of velocity with depth, but this increase with depth is not supported by the in-hole velocity logs. The beach at the Chariot site was found to be in a steady-state condition and not advancing toward the land at a rate that is significant. Erosion behind the beach is thought to be in the order of 1 or 2 feet a century. The net alongshore transport of sediments is approximately 5 cubic yards an hour to the southeast during the ice-free periods. However, during heavy storms the beach transport of sediments may be more than 1,000 cubic yards per hour. It was proposed that jetties be constructed on each of the excavated channels to accommodate the volume of material that may be moved during these storms. Shallow and deep aquifers exist in the test site area. The shallow aquifers consist principally of unconsolidated material dependent upon recharge from surface sources during the summer. The deep aquifers are in permeable portions of bedrock and receive recharge water from distant sources. Both types of aquifers may be contaminated by any radioactive fallout from the proposed nuclear test. The shallow aquifers would receive contaminated surface water immediately, whereas it may take years for the deep aquifers to receive the contaminated surface water. The suspended sediment discharge of Ogotoruk Creek is considered minor compared to the size of the proposed excavation. The chemical composition of the waters indicates springs as well as surface water exist in the vicinity of the test site. The radiochemical levels of the fresh waters are low and in the same magnitude as are normally found. The highest beta activity of the fresh waters was found in two ponds approximately 6 miles north of the test site, and might be ascribed to fall-out which has accumulated from previous detonations and which was not flushed out owing to lack of natural drainage. The chemical composition of the water of a larger control pond to the east is unusual for the area, in that it has a high mineral content. For all practical purposes no flow occurred in

Ogotoruk Creek from October 1, 1958, to late in May 1959. (auth)

18033 WT-1528

Stanford Research Inst., Menlo Park, Calif.

SURFACE MOTION FROM AN UNDERGROUND DETONATION. L. M. Swift and D. C. Sachs. Apr. 1, 1959. 82p. Project 26.4a [of] OPERATION PLUMBBOB. OTS.

Surface and near-surface acceleration and strain were measured on a deep underground nuclear burst to permit extrapolation of results to nuclear detonations of other yields under different test or employment conditions. Results indicate that a large earth cap, probably including more than one chunk, separated from the mesa over the charge and subsequently fell back into place. The only significant vertical displacement occurred at or near ground zero and reached a maximum of approximately 0.9 feet. Both acceleration and horizontal surface strain measurements suggest that the principal disturbance on the mesa surface was confined to a small region around ground zero; however, the measurements on the slope indicate significant earth motion. Velocity data indicate that the layering characteristics of the medium exert a great influence upon the severity of the ground motion. The displacement-time data at surface zero agrees well with photographic data. In general, the peak displacements indicate that the cap rock moved up and away from surface zero, whereas the permanent displacements on the mesa show that the final positions of the stations are downward and inward toward surface zero, relative to preshot position. From the preshot seismic survey and average velocities computed from the arrival time data, it is concluded that the medium of the Rainier mesa is many-layered with seismic velocities that are widely different. A reasonable profile is 5000 ft/sec from the surface to 200 feet, 10,000 ft/sec to 300 feet, and 6600 ft/sec to 1000 foot depth. Although predicted strains were higher than those observed, horizontal surface strain results support the conclusion that the principal disturbance on the mesa was confined to a relatively small radius around surface zero. Peak strains measured on the slope are significantly larger than expected at comparable ranges on the mesa. (auth)

18034 AEC-tr-3968

THE USE OF THE GEOBOTANICAL METHOD IN GEOLOGICAL AND HYDROGEOLOGICAL INVESTIGATIONS. (Ispol'zovanie Geobotanicheskogo Metoda pri Geologicheskikh i Gidrogeologicheskikh Issledovaniyakh). S. V. Viktorov—S. Yu. Geller, ed. A translation from a publication of the Publishing House of the Academy of Sciences, USSR, Moscow, 1955. OTS.

The first chapter of this volume gives a brief historical sketch of the development of the geobotanical method in geological and hydrogeological investigations. In the second chapter the solid-forming rock is considered as a botanico-geographical factor. The last chapter discusses plant cover features of value in investigations using geological indicators. (W.L.H.)

18035 AEC-tr-4099

RADIOACTIVE DENSITY DETERMINATION WITH THE GAMMA-GAMMA-PROBE. Radioaktive Dichtebestimmung mit der Gamma-Gamma-Sonde). Joachim Homilius, Siegfried Lorch, and Konrad Seitz. Translated from Geol. Jahrb. 75, 183-96(1958). 19p. JCL.

A report is given on systematic experimental and theoretical research on the determination of the density of water in soils by radioactivity. In the method developed, a hollow tube is driven down to the level under measurement and an arrangement of "source–lead shielding–counter tube" was introduced. The density of the surrounding substances was determined by the scattering and absorption of the gamma rays. The counting rates and the test volume are determined by the spatial distribution of the scattering centers around the body of the probe; they are determined as functions of the soil density and the geometry of the arrangement. The influence of the air gap between the probe and the wall of the bore hole is among the sources of error discussed. It can be shown that the relative error in density data for the case of homogeneous soils and optimum dimensioning of the apparatus is less than ±2 percent. Examples are given to show new characteristic applications of the probe for the investigation of building sites and the results are compared with the usual older methods. (auth)

18036 SCL-T-300

THE PRECISION OF THE AZIMUTHAL METHOD OF DETERMINING THE COORDINATES OF THE EPICENTER. (O Tochnosti Azimutal'nogo Sposoba Opredeleniia Koordinat Epitsentra). I. L. Nersesov and V. A. Tokmakov. Translated by Marcel I. Weinreich (Sandia Corp.) from Trudy Inst. Seismol., Akad. Nauk Tadzhik. S.S.R. 54, 57-77(1956). 21p. JCL or LC.

The method of determining the location of an earthquake center with the azimuth of propagation of elastic vibrations is discussed. Causes affecting errors in calculation are examined. (C.H.)

18037

METEOROLOGY DIRECTS WHERE BLAST WILL STRIKE. Everett F. Cox, H. J. Plagge, and J. W. Reed (Sandia Corp., Albuquerque, N. Mex.). Bull. Am. Meteorol. Soc. 35, No. 3, 95-103(1954) Mar.

Seismological exploration companies and Defense Department proving grounds occasionally experience liability suits for damage wrought by explosions. Good forecasts of troposphere temperature and wind structure can be used to predict where shocks will strike, and with fair accuracy whether or not the shock will crack windows. Formulas are derived by which these predictions may be made. (auth)

18038

THE ORE DEPOSITS OF MOUNANA (GABON). X. des Ligneris and J. Bernazeaud (Compagnie des Mines d'Uranium, Franceville, Middle Congo). Bull inform. sci. et tech. (Paris) No. 38, 4-19(1960) Apr. (In French)

Mounana is situated in the southeast part of Gabon in the Franceville District of the Haut-Ogooue region. The geology of the region is outlined, and the methods used in the radioprospection of the region are discussed. The ore deposits are essentially urano-vanadiferous mineralizations of Francevillite and black oxides. It is estimated that the reserves amount to approximately a million tons of ore with an average uranium content of 4%. The developmental program planned and the technical and human problems involved in the program are briefly discussed. (J.S.R.)

18039

RADIOACTIVE CONTAMINATIONS IN THE HORIZONTAL DRILLINGS MADE WITH THE DRILL HAMMER. P. Fabre. Bull. inform. sci. et tech. (Paris) No. 38, 20-6(1960) Mar. (In French)

In order to define with precision the known uranium formations and to discover new formations, horizontal drillings from mine shafts have been used. Several times, however, high γ readings were shown to be without any direct connection with the mineralization. Also, radiosamplings made at intervals of several days showed variations in the

γ intensities and in the position of these anomalies. To overcome this possible radon contamination, the radiosampling is done at least 24 hr after the drilling. However, mineral splinters still cause variations in the result. The use of a β and γ probe permits the determination of the degree of γ contamination. (J.S.R.)

18040

PROBLEMS RELATIVE TO THE RADIOMETRIC "WEIGHING" OF RADIOACTIVE ORES. P. Formery and V. Ziegler. Bull. inform. sci. et tech. (Paris) No. 38, 27-33(1960) Mar. (In French)

It is necessary for a mine operator to know with precision the production of the mine, that is, to know the metal contents of the ore. With radioactive metals the radiation can be used to estimate the "weight" of the ore. A formula expressing the relationship between the metal content of the ore and the radioactivity is derived. The permissible fluctuation permitted in the radioactivity measurements is determined. (J.S.R.)

18041

SOME RECENT APPARATUS USED FOR THE PROSPECTION AND STUDY OF RADIOACTIVE ORES. J. Berbezier. Bull. inform. sci. et tech. (Paris) No. 38, 44-7(1960) Mar. (In French)

Instruments recently developed for use in prospecting are briefly described. The instruments described include an ultraviolet light (used to detect fluorescing uranium minerals), a portable scaler (useful when scintillometry fails), ground potentiometer (for study of non-crystalline formations, schists, and metamorphic schists), solar battery (to convert light energy into direct current), and a radiometric device to measure the thorium content of mixed ores. (J.S.R.)

18042

THE INFLUENCE OF TURBULENT DIFFUSION IN THE DIRECTION OF THE WIND ON THE DISTRIBUTION OF THE CONCENTRATION OF A SUBSTANCE THAT IS BEING DIFFUSED IN THE ATMOSPHERE. I. L. Karol (Inst. of Applied Geophysics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1283-6(1960) Apr. 21. (In Russian)

In the theory of atmospheric processes (turbulent diffusion of admixtures, the influence of the floor surface on air mass transformation, etc.) described by the semi-empirical equation of turbulent diffusion, diffusion in the direction of the wind is ordinarily neglected in the analysis of stationary processes and it is assumed that the coefficient of turbulent diffusion $K_x = 0$. An attempt is made to substantiate the suggested assumption and to evaluate the influence of turbulent diffusion in the O_x direction for the case of a single stationary point source. (R.V.J.)

18043

THE ABUNDANCE OF THE RARE EARTH ELEMENTS IN RELATION TO THEIR ORIGIN. S. R. Taylor (Univ. of Cape Town). Geochim et Cosmochim. Acta 19, 100-12 (1960) Apr. (In English)

The abundances of the rare-earth elements given by Suess and Urey are correlated with the processes of formation of the individual nuclides listed by Burbidge et al. It is shown that the smoothing process carried out by Suess and Urey leads to relative depression of the s-process nuclides and elevation of those formed by the r-process. Later abundances published by Cameron accentuate this trend. His Ce/Nd ratio necessitates major fractionation between the earth and chondrites. (auth)

18044

ISOTOPIC COMPOSITION OF LEAD IN PEGMATITIC FELDSPARS. E. J. Catanzaro and P. W. Gast (Lamont Geological Observatory, Palisades, N. Y.). Geochim et Cosmochim. Acta 19, 113-26(1960) Apr. (In English)

An ion-exchange method was developed for extracting microgram quantities of lead from pegmatitic feldspars. The isotopic composition of lead in feldspars ranging from 350 to 2750 million years (m.y.) in age was determined. Model ages were calculated and were generally found to be in good agreement with independent age determinations. The results are compatible with a lead model stipulating relatively short periods of time in a crustal environment for the lead. In one instance where there was a large discrepancy between the model age and the known age, because of excess radiogenic lead in the feldspar, the anomaly was resolved by acid leach experiments which preferentially removed the excess radiogenic lead. The lead content of twenty-five feldspars was measured and found to be <20 ppm to 500 ppm. (auth)

18045

A SEARCH FOR VARIATIONS IN THE NATURAL ABUNDANCE OF URANIUM-235. A. N. Hamer and E. J. Robbins (United Kingdom Atomic Energy Authority, Capenhurst, Ches., Eng.). Geochim et Cosmochim. Acta 19, 143-5 (1960) Apr.

The results are described of a comparison of uranium isotopic composition in ore concentrates by high-precision gas source mass spectrometry. An equation is given for the maximum possible percentage deviation of the isotopic ratio of a given ore from that of the mean. From the data obtained, the variations in the relative abundance of the principal isotopes of uranium are < 0.05%, compared to earlier values of 0.93% (Nier) and 0.46% (Senftle et al). (B.O.G.)

18046

EXPOSURE AGES FOR IRON METEORITES. Oliver A. Schaeffer and David E. Fisher. Nature 186, 1040-2(1960) June 25.

Results of measurements of the ratio of He^3/Ar^{38} and the He^3 content of iron meteorites were used in estimating the age of a number of meteorites. The data are arranged in a histogram from which it can be seen that the exposure ages show a variation extending to nearly two thousand million years with a most probable value near 100 to 200 million years. The data are interpreted as indicating a continual breaking-up process of bodies in space, leading to freshly exposed surfaces. The significance of these findings in interpreting measurements from other laboratories is discussed. (C.H.)

18047

NUCLEAR FISSION IN THE EARLY HISTORY OF THE EARTH. P. K. Kuroda (Univ. of Arkansas, Fayetteville). Nature 187, 36-8(1960) July 2.

Differences in the isotopic ratios of xenon in the Earth's atmosphere and in the Richardson meteorite are discussed. The differences indicate that at least 10% of the atmospheric xenon-136 is fissiogenic. This is much greater than that expected from the uranium-238 spontaneous fission alone but can be explained as due to the spontaneous fission of some of the extinct trans-uranium elements and/or the induced fission of uranium-235 in the early history of the Earth. Published data on the terrestrial abundance of various isotopes and mass-yield curves of uranium-238 from spontaneous fission, uranium-235 from neutron-induced fission, and curium-242 from spontaneous fission are discussed. Differences in the isotopic ratios of xenon in the Earth's atmosphere and the cosmic abundance ratios for xenon isotopes are also considered. (C.H.)

18048

URANINITE OCCURRENCE IN HEAVY MINERAL SANDS OF THE INDUS VALLEY. Günter Zeschke. Neues Jahrb. Mineral. Abhandl. 93, 240-56(1959) Oct. (In German)

In the gold-rich sands of the Indus River, especially in the northern part of West Pakistan, uraninite, monazite, scheelite, zircon, ilmenite, and previously unknown minerals were discovered. Uraninite exhibits an abnormally high radioactivity which could be traced back to the decay products of the radium series. The type of radiation was investigated and discussed. Chemical and physical separations were made to detect the radiation source. Uraninite is especially enriched in the smallest grains, generally in idiomorphic form. The occurrence was compared with other known occurrences. It was shown that a weathering of uraninite can follow different patterns and that a liquid transport of several 50 km as well as an enrichment in alluvial ores results. The economic possibilities were mentioned. (tr-auth)

18049

CRYSTAL CHEMICAL AND MAGNETIC STUDIES OF GARNET SYSTEMS. $\{YCa_2\}[M_2^{4+}](Fe_3)O_{12}$—$\{Y_3\}[Fe_2](Fe_3)O_{12}$, M = Zr or Hf. S. Geller, R. M. Bozorth, C. E. Miller, and D. D. Davis (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. and Chem. Solids 13, 28-32 (1960) May. (In English)

A complete solid-solution range exists in the system $\{YCa_2\}[Zr_2](Fe_3)O_{12}$—$\{Y_3\}[Fe_2](Fe_3)O_{12}$. The Zr^{4+} ion is even larger than the Sn^{4+} ion and in this system apparently prefers only the octahedral sites. The behavior of the plot of $n_B(\infty,0)$ vs. composition is similar to that of the $Ca_3Fe_2Sn_3O_{12}$—$Y_3Fe_2Fe_3O_{12}$ system and corroborates the interaction model for garnets recently derived by Gilleo. A small spontaneous magnetization is observed in the garnets $\{YCa_2\}[Zr_2](Fe_3)O_{12}$ and $\{YCa_2\}[Zr_2](Me_{0.5}Fe_{2.5})O_{12}$, Me = Al and Ga, indicating the establishment of magnetic sublattices among the tetrahedral sites. The garnet $\{YCa_2\}[Hf_2](Fe_3)O_{12}$ is readily formed. The Hf^{4+} ion, which is very nearly the same size as that of Zr^{4+}, also prefers the octahedral site. (auth)

HEALTH AND SAFETY

18050 AECL-990(Paper 12)

Atomic Energy of Canada Ltd., Chalk River, Ont.

HEALTH CONSIDERATIONS IN REACTORS. G. C. Butler. Paper 12 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 9p.

The protection of reactor workers from radiation is discussed, and the effects this has on the design of buildings and equipment are indicated. Some specific examples of provisions necessary to protect reactor workers from external and ingested radiation are considered. (W.D.M.)

18051 CEX-58.7

Holmes and Narver, Inc., Los Angeles.

AEC GROUP SHELTER. Jan. 1960. 31p. OTS.

As a result of atomic shelter tests and field experiments conducted over the past nine years, it has been conclusively shown that shelters provide the only promising means of civilian protection in the event of a nuclear war. Design details are presented for a group shelter to accommodate 100 persons of all age groups and both sexes. The shelter structure is a multiplate corrugated-steel arch set on a concrete slab with end walls of bridge plate sheathing. The entire structure is covered with a minimum of 3 feet of earth. The shelter combines outstanding protection against radioactive fall-out with good protection against blast and thermal radiation. Drawings are included. General operating procedures are outlined. (C.H.)

18052 CF-57-3-152

Oak Ridge National Lab., Tenn.

RADIATION DOSE RECEIVED BY PASSENGERS AND CREW ON PLANES CARRYING THE MAXIMUM NUMBER OF RADIATION UNITS. D. M. Davis, J. C. Hart, and A. D. Warden. Mar. 1, 1957. 22p. Contract [W-7405-eng-26]. OTS.

Direct measurements were made to determine radiation exposures which might occur under current regulations governing the transportation of radioactive materials by air. Measurements were made on five types of airplanes, DC-3, DC-6, DC-7, Convair 340, and Viscount. Cesium-137 and cobalt-60 sources in shipping containers and packaged in the same manner as a regular isotope shipment were placed in the cargo compartment. Measurements were made in all locations which would be occupied in flight by passengers or crew members. Data are tabulated. It is concluded that exposures in excess of 10 mr/hr may result when 40 units of cobalt-60 or cesium-137 are carried on some types of planes. Unless due caution is taken in loading the isotope, exposures in excess of Handbook 59 values will be encountered. (C.H.)

18053 FFIF-IR-F-392

Norway. Forsvarets Forskningsinstitutt, Lillestrøm.

METEOROLOGICAL FRACTIONATION OF NUCLEAR BOMB DEBRIS. Per B. Storebö. Nov. 1959. 14p.

Radioactive particles are produced by nuclear bomb explosions which are widely different in size and nature. Systematic differences in properties are expected for particles formed under different circumstances. Different particles may be sorted by systematic differences between weather trends at different geographical locations, and closer examination of deposits may thus bring information about the particles. A mountain station in Norway had deposits which appeared to contain more short-lived fission products than the lowland stations, especially in periods when much freash fission products were present in the atmosphere. This is explained either by a substantial chemical fractionation on larger particle sizes taking place during formation, or by particles somewhat larger than 0.5 μ diameter being generally formed from high-yield explosion debris. The large particles will set a limit to the atmospheric residence time. (auth)

18054 HASL-88

New York Operations Office. Health and Safety Lab., AEC.

FALLOUT PROGRAM QUARTERLY SUMMARY REPORT [FOR] MARCH 1, 1960 THROUGH JUNE 1, 1960. Edward P. Hardy, Jr., Stanley Klein, and Joseph Rivera. July 1, 1960. 258p. OTS.

Current information from the HASL Fallout Program is summarized. Information is also included from the U. S. Naval Research Laboratory, Los Alamos Scientific Laboratory, and Western Germany. Data are tabulated that have become available during the period March 1 to June 1, 1960, on radioactivity in deposited fall-out and in soil, air, water, milk, bread, other foods, and in human and animal bone. Interpretive reports on the levels of tungsten-185 and of strontium-90 in deposited fall-out, in soil, and in adult and infant diets are also included. A bibliography of recent literature is included. (auth)

18055 NP-8810
Ammann and Whitney, New York.
ENGINEERING STUDY OF ATOMIC BLAST RESISTANT DESIGN FOR SEVERAL DIFFERENT BUILDING TYPES. Mar. 1960. 205p., 70 illus. Includes Appendices A–H. Contract DA-49-129-ENG-317.

Results are presented from an engineering study of several building types to determine the practicability of design for atomic blast resistance, the estimated construction cost for a range of blast pressure loadings, a comparison of construction costs with conventional construction, and the estimated additional cost of providing personnel shelter areas. Blast-resistant designs and construction cost estimates are included for standard structures such as administrative, communications, and warehouse buildings and for nonstandard structures such as earth-covered or completely buried concrete igloos, rectangular concrete buildings, and buildings with concrete domes. Data on radiation attenuation by shelters and pressure criteria for entrances are appended. Drawings illustrating design features are included and data are tabulated. (C.H.)

18056 TID-6132
Massachusetts Inst. of Tech., Cambridge.
A PILOT STUDY OF THE HORIZONTAL TRANSPORT OF FISSION PRODUCTS IN THE TROPOSPHERE. Reginald E. Newell. May 15, 1960. 24p. Contract [AT](30-1)-2241. OTS.

Computations of the meridianal transport of fission product radioactivity are presented for a longitude of approximately 80° West. A meteorological interpretation of these data is included. (J.R.D.)

18057 Y-1092(Del.)
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
NEUTRON DOSE CALIBRATION OF INDIUM PERSONNEL DOSIMETERS FOR PROMPT-CRITICAL METAL BURSTS. J. W. Wachter and L. C. Emerson. Mar. 1, 1956. Decl. with deletions Aug. 13, 1959. 31p. Contract W-7405-eng-26. OTS.

Thermoplastic personnel security badges containing a 0.9 gm indium foil were mounted on tissue-equivalent phantoms placed 1 to 4 m from the unmoderated, untamped, Oralloy reactor, Godiva, and subjected to radiation from prompt-critical bursts of about 10^{16} fissions. Badge activities immediately after exposure ranged from 50 mr/hr to 1 mr/hr for exposures made out-of-doors, and 150 to 10 mr/hr, respectively, for exposures made indoors. Curves are presented which relate, for given burst intensity, the total neutron and prompt gamma dose to badge activity as measured with a beta-gamma survey meter. Using these curves, a grouping of irradiated persons is possible in which those having had less than an LD_{10} and those having had more than an LD_{100} can be separated from those whose lethal probability is high but uncertain. Approximately $^1/_{100}$ of an LD_{100} dose could be detected 1 hour after a burst. For each phantom, the activity difference between badges facing toward and facing away from the reactor correlated linearly with dose, independent of distance and burst intensity, suggesting that the dose delivered to persons wearing an indium-loaded belt could be determined to an LE(0.05) of ±30 rem for doses greater than 50 rem. (auth)

18058
LONG-LIVED RADIOACTIVE AEROSOLS. J. A. Schedling (Universität, Vienna). Acta Phys. Austriaca 13, 207-23 (1960). (In German)

A survey is made of the recent research on radioactive aerosols. The source of these aerosols is described with special treatment of the relationship between type of fallout and the type of bomb. The methods and apparatus used in the collection and measurement of aerosol particles are described. Evaluation of the measurements is considered. The recent detection of particles with high specific activity is then discussed and the results of their study are presented. 28 references. (J.S.R.)

18059
CONTRIBUTION TO THE STUDY OF THE DOSIMETRY OF HIGH FLUXES OF IONIZING RADIATIONS. Jacques Prévé and Gabriel de Gaudemaris (Centre d'Études Nucléaires, Grenoble, France). Compt. rend. 250, 3470-2(1960) May 23. (In French)

Different methods for the dosimetry of high fluxes of γ radiation (1.2×10^6 rad/hr) and of accelerated electrons (10^8 rad/hr) were tested. The most precise methods are based on the ceric-cerous system and on the release of gas by cyclohexane. (tr-auth)

18060
SYSTEMATIC MEASUREMENTS OF RADIOACTIVITY OF ATMOSPHERIC PRECIPITATIONS AND PROOF OF PRESENCE OF ARTIFICIAL RADIOACTIVITY IN THE ATMOSPHERE. V. Santholzer, J. Podzimek, and J. Macku. Czechoslov. J. Phys. 8, 716-21(1958). (Translated from Referat. Zhur. Khim. No. 23, 1959, abstract No. 81825).

The measurement of the radioactivity of atmospheric precipitations for the period from 1956 to 1958 showed a sharp increase of radioactivity in the middle and at the end of 1957. The radioactivity of precipitations was mainly due to the presence of the product of disintegration of U^{235} and Pu^{239}. A decrease of radioactivity with time, proved by the method of extrapolation, serves as a confirmation of the surmise regarding the presence of artificial radioactivity in the atmosphere. The magnitude of this radioactivity constitutes 10^{-10} to 10^{-9} curie per 1 liter of collected atmospheric precipitations.

18061
MEASUREMENT OF GONAD DOSE RECEIVED DURING RADIOLOGICAL EXAMINATION. A. Meyers, I. Kozlowitz, and P. Kipfer (Université Libre, Brussels). J. belge radiol. 42, 100-9(1959). (In French)

Preliminary results are given for measuring, for the entire Belgian population, the doses to the gonads in patients submitted to radiodiagnostic examination of the routine type. On the whole the results are of the same nature as those obtained abroad; they are, however, slightly lower. (auth)

18062
DEMOLISHING OF A BUILDING CONTAMINATED WITH RADIATION. Jaromil Čeřovský (Chemoprojekt, Prague) and Eduard Malášek (UVVVR, Prague). Jaderná energie 6, 184-7(1960). (In Czech.)

A laboratory building contaminated with about 200 mc Ra^{226} which could not be decontaminated was destroyed and the materials were transported to a radioactive waste pit. Experience in using safety devices, the data of work organization, the results of dose rate control, and the evaluation of individual devices and measures for building demolition are reported. (auth)

18063
RADIATION PROTECTION TECHNIQUES. Kernenergie 1, 221-2(1958) Mar. (In German)

Some radiation protection devices on display at the Atomic Pavillion of the All-Union Industrial Exhibition are briefly described. An apparatus for testing shielding materials, remote manipulators, protective clothing, and electronic instruments are included. (T.R.H.)

18064
RADIATION PROTECTION CONTROL WITH FILM DOSIMETERS. G. Böhler (Deutsche Akademie der Wissenschaften, Berlin-Buch). Kernenergie 1, 440-4(1958) June. (In German)

A study was made of the possibility of extending the useful range of commercial x-ray film dosimeters to the high-energy gamma radiation of radioactive isotopes. A difference in darkening distribution would be produced according to whether a γ or x-ray exposure was the case. The results in the case of γ rays indicate an increasing uncertainty in the densitometric evaluation of the film darkening and dose relation (tr-auth)

18065
HEALTH PHYSICS INSTRUMENTATION. [PART] 4. Denis Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). Nuclear Power 5, No. 51, 88-92(1960) July.

Measurement of low-level radioactivity in liquids, gases, and human beings is discussed. (1) Liquids. When mixed fission products are monitored, windowless counting is an advantage in that it counts the low-energy as well as the higher-energy radiations. One device for doing this, called the Swirl Counter, is described; it allows β-γ counting down to ca. 10^{-5} c/l. Usually the best method of counting liquids is by pumping part of it through a sample vessel in which a detector is mounted; Smith's apparatus (constant volume) is described as an example. Very low activities requiring laboratory processing is next considered; various methods are given, e.g., evaporation of liquid in a depression and subsequent counting of the residue, ion-exchange resin in which a detector is present. The latter can detect 10^{-9} curies of β activity. A device for monitoring α activity in the presence of β-γ activity in effluents is also described, with which α activities down to 10^{-4} c/l have been measured. (2) Gases. Monitoring of air for β-γ activity is easy, but α emitters such as Pu are difficult to measure because of the masking effect of active decay products of radon always present in air. Methods are given for eliminating this difficulty by allowing the short-lived products to decay or utilizing the difference in size or radiation energy. Other gas-monitoring problems discussed are the monitoring of tritium, iodine in coolant channels, and Ar^{41} in stacks. (3) Human Beings. Two methods are described; excretion studies and external measurements. It is necessary to allow for K^{40}, a naturally occurring radioisotope. Possible measuring devices are described; as an example, Am^{241} which entered the body via a puncture wound was measured. (D.L.C.)

18066
BERYLLIUM IN REACTORS—THE HEALTH PROBLEM. R. O. R. Brooks (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 5, No. 51, 94-6 (1960) July.

Be and BeO are not dangerous except in the dust or fume condition in air, and such dust arises from four main causes: (1) poor compacting, (2) movement of components, (3) prolonged neutron bombardment, and (4) temperature effects. In (1), more than 25 μg Be can accumulate on 40-in.^{2} surface area, while (2) results in dust from abrasion, and (3) may produce dust by causing either chemical dissociation of BeO into its elements or swelling of the component due to gas formation. Gas formation was found to be small except for incompletely dried BeO; water is also a hazard in the vaporization of BeO in that it lowers its vaporization temperature. Production of fumes is likely only in the event of fire (4). The best safety measure for the prevention of environmental contamination by Be dust or fume appears to be the use of a closed system, and such a system for a stack of several thousand BeO bricks is described. The desirability of instantaneous air monitoring equipment for Be is emphasized. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

18067 AD-227845
Department of Agriculture. Western Utilization Research and Development Div., Albany, Calif.
RADIATION PRESERVATION OF POULTRY PRODUCTS. Report No. 3 (Progress) [for] Period November 1, 1958 through January 31, 1959. Hans Lineweaver. 3p. Project No. 7-84-01-002.

Progress is reported in the development of procedures for the assay of residual proteinase activity in heated muscle tissue. Cut-up chicken fryers will be heated to inactivate enzymes before or after receiving a sterilizing dose of ionizing radiation. Equipment for the rapid measurement and recording of changing temperature in the heated chicken muscle was calibrated and tested. (C.H.)

18068 AD-227903
General Mills, Inc. Central Research Labs., Minneapolis.
FUNDAMENTAL STUDIES OF RADIATION SOURCE DOSIMETRY AND THE EFFECTS OF IONIZING RADIATION ON SUGARS. Report No. 6 (Progress) [for] January 1, 1959—March 31, 1959. J. S. Andrews. 11p. Project No. 7-84-01-002. Contract QMR E (Natick) No. 78.

Partial separation of the irradiation products of glucose from the unchanged glucose in irradiated solutions was accomplished by adsorption on activated charcoal, by formation of lead salts, by paper chromatography, and by paper electrophoresis. Formic and gluconic acids were identified as products of the irradiation of 1 molar glucose solution in the range of 5 to 25 megarads. Using the cellophane-dye dosimeter, surface-burn measurements reported earlier for a canned product irradiated in spent fuel element sources were extended to include a water-shielded cobalt-60 source. This phenomenon results in an anomalous high dose in a product which is in close proximity to a high atomic number material, for example a can wall, when irradiated in a field with low-energy components in the energy spectrum. For a cobalt-60 facility the surface burn amounts to a 10% overdose within 0.001 in. of a can wall and extends into the can contents to a depth of approximately 0.02 gm/cm^2. Also, the dose variation occurring in a No. 2 can of masonite irradiated in a cobalt-60 source is reported. The results have taken into consideration the inherent field variation so as to be interpreted as due to the attenuation in the product itself. A variation of about 20% from the dose at the center of the can, excluding all surface burn effects, was measured. This work is continuing. (auth)

18069 AD-228092
Kentucky. Univ., Lexington.
EXTENSION OF STORAGE LIFE OF FRESH FRUIT AND VEGETABLES BY IONIZING RADIATION. Report No. 3 (Progress) [for] Period: October 27, 1958—January 26, 1959. D. C. Martin. 4p. Project No. 7-84-01-002. Contract QMR&E (NATICK) No. 87 (Agreement).

Results are presented from taste panel ratings of irradiated canned broccoli and cauliflower. Samples exposed to the lower radiation dosage (0.5×10^6 rads)

rated about the same as the control held at 45°F. Data are tabulated. (C.H.)

18070 AD-228093
Kentucky. Univ., Lexington.
THE EXTENSION OF STORAGE LIFE OF FRESH FRUITS AND VEGETABLES BY IONIZING RADIATION. Period [covered]: June 27, 1958—October 26, 1958. D. C. Martin. 4p. Project No. 7-84-01-002. Contract QMRE&E (NATICK) No. 87 (Agreement).

Results are reported from taste tests on irradiated canned corn. All samples were less acceptable than frozen controls but rated higher in flavor than controls maintained at 45°F. Data are tabulated. (C.H.)

18071 AD-230342
Southern Research Inst., Birmingham, Ala.
DETERMINING THE FUNCTIONAL PROPERTIES OF FOOD CONTAINERS USED FOR FOODS IRRADIATED IN COMBINATION WITH MODEL FOOD SYSTEMS. Report No. 16 (Progress) [for] January 25, 1959—March 24, 1959. Charles E. Feazel. 26p. Project No. 7-84-01-002. Contract DA-19-129-QM-759.

The object of this work is to study factors that affect stress-cracking and the production of extractives in plastic packaging materials for foods to be preserved by irradiation. Several types of polyethylene were tested in solutions of Igepal CO-630 and lactic acid. They were also tested in homogenized milk and in water slurries of beef, pork, pork sausage, cheese, fish, green beans, and apples. All samples received 1.0, 3.0, and 6.0 megarads of gamma radiation. Unirradiated controls were studied for the solutions, but not the foods. Low-density polyethylenes were more resistant to stress-cracking than medium- and high-density polyethylenes. Samples having high molecular weight and low melt index were the most resistant to stress-cracking. Irradiation improved the resistance to stress-cracking of all samples, but was proportionally more beneficial to the higher-molecular-weight samples. Igepal CO-630 was the most effective stress-cracking agent. The stress-cracking was directly related to surface tension, except for Igepal CO-630. The work reported here completes the stress-cracking work on polyethylene. (auth)

18072 AD-230344
West Virginia Pulp and Paper Co., [Tyrone, Penna.]
STUDIES TO DETERMINE OPTIMUM CHARACTERISTICS OF IN-PACKAGE ACTIVATED CHARCOALS FOR REMOVAL OF "IRRADIATION FLAVOR" DURING STORAGE. Report No. 4 (Progress) [for] December 10, 1958 to April 9, 1959. Henry F. Laughlin. 9p. Project No. 7-84-01-002. Contract DA-19-129-QM-1212.

Threshold odor tests on irradiated beef which had been packaged with granular active carbons showed that a carbon dosage of 1% based on weight of meat removed from 20 to 30 per cent of the irradiation odor, while dosages of 2% removed 40 to 50 per cent of the odor. Higher carbon dosages are indicated as most observers felt the odor was still too objectionable to make the meat edible. Data showing the correlation between surface area and adsorptive capacity for iodine and phenol are included. (auth)

18073 AD-231949
Southern Research Inst., Birmingham, Ala.
DETERMINING THE FUNCTIONAL PROPERTIES OF FOOD CONTAINERS USED FOR FOOD IRRADIATED IN COMBINATION WITH MODEL FOOD SYSTEMS. Report No. 17 (Progress) [for] March 25, 1959—May 24, 1959. Charles E. Feazel. 19p. Project No. 7-84-01-002. Contract DA-19-129-QM-759.

The object of this work is to study factors that affect stress-cracking and the production of extractives in plastic packaging materials that are to be used with foods preserved by irradiation. Polystyrene, polyamides, polyesters, and polypropylenes were tested in homogenized milk, in solutions of Igepal CO-630 and solutions of lactic acid, and in water slurries of ground beef, ground pork, pork sausage, cheese, fish, apples, and green beans. All materials, except polyesters, received 1.0, 3.0, and 6.0 megarad of gamma radiation. Polyesters received 6.0 megarad of gamma radiation only. Unirradiated samples were also tested with the solutions. Irradiation decreased stress-cracking of polystyrenes of which the extra-high impact polystyrenes were the most crack resistant. Food slurries were effective stress-cracking agents for polystyrene; Igepal CO-630 solutions and lactic acid solutions did not affect them. Samples of polyesters, polyamides, or polypropylene were not cracked by any of the media. (auth)

18074 AD-231954
Florida State Univ., Talahassee.
STABILIZING IRRADIATED MEATS AGAINST OXIDATIVE CHANGES DURING STORAGE. Report No. 3 (Progress) [for] period April 1, 1959—June 30, 1959. Betty M. Watts. 15p. Project No. 7-84-01-002. Contract DA19-129-QM-1321.

An improved distillation method is described for the quantitative determination of malonaldehyde in foods containing oxidized fats. Evidence is presented that the triglycerides are not primarily involved in tissue rancidity. Untrained consumer type preference panels found no difference between rancid (high TBA) and nonrancid pork samples. Applications in the stabilization of irradiated meats against oxidative changes during storage are discussed. (C.H.)

18075 NYO-9181
Massachusetts Inst. of Tech., Cambridge.
SUMMARY OF FINDINGS ON STRONTIUM-90 AND CESIUM-137 PROCESS CONTROL DEVICES. Final Report. Samuel A. Goldblith. Apr. 30, 1960. 19p. Contract AT(30-1)2329, Task V. OTS.

With this is Bound—as appendix B: Food and Drug Administration, Washington, D. C. LETTER FROM EINAR T. WULFSBERG, Dated March 16, 1960.

A study was made on the effects of ionizing radiations from strontium-90 and cesium-137 on typical radiosensitive food materials such as orange juice and radiosensitive chemical compounds such as Vitamin C and 10 per cent solution of sodium chloride. Results show a factor of safety of greater than 50,000 insofar as chemical changes are concerned, even in the most sensitive of systems. No induced radioactivity was produced. It is concluded that no public health hazard exists in the use of ionizing radiations from strontium-90 and cesium-137 when these are used for process control devices in the food industry. (C.H.)

18076 NYO-9182
Massachusetts Inst. of Tech., Cambridge.
EVALUATION OF THE TECHNICAL, ECONOMIC AND PRACTICAL FEASIBILITY OF RADIATION PRESERVATION OF FISH. B. E. Proctor, S. A. Goldblith, J. T. R. Nickerson, and D. F. Farkas. [Apr. 1960]. 81p. Contract AT(30-1)-2329. OTS.

The present status of the technology of the radiation preservation of marine products is reviewed. Based on exploratory studies conducted over a six-year period, it is concluded that low dose substerilization radiation processing of certain selected sea foods can provide ad-

vantages for the procurer, processor, distributor, and consumer of edible marine products. It is recommended that a comprehensive, synchronized government-industry program be initiated for the development of substerilized, radiation processed, marine products. (C.H.)

18077 TID-6060
Goodyear Tire and Rubber Co., Akron, Ohio.
ISOTOPIC METHOD FOR AGE DETERMINATIONS OF INDUSTRIAL PRODUCTS. Monthly Progress Letter for April 1960. T. C. Gregson and L. B. Bangs. 3p. Contract AT(11-1)-719. OTS.

Research was continued on the determination of ages of industrial products by isotopic methods. Gasoline samples were dated with P^{32}-labeled tricresyl phosphate and a standardized C^{14}-labeled stearic acid. An accelerated age study was made by assuming that (a) four P^{32} half lives constituted an age period, (b) the P^{32} activity was 4 to 0.25 times the C^{14} activity during this interval, and (c) the quantities of both isotopes be fixed to satisfy the requirements for exempt pair concentrations. The ages generated from the data are summarized. After the lapse of one half life, the accuracy of the method appears to be entirely adequate. This shows the feasibility of making age determinations with exempt concentrations of isotopes. (B.O.G.)

18078 TID-6104
Tracerlab, Inc., Waltham, Mass.
SUMMARY OF A SURVEY OF APPLICATIONS FOR AN X-RAY RAYLEIGH SCATTERING GAGE. [Period covered] April 15--May 15, 1960. 6p. Contract AT(30-1)-2538. OTS.

A survey of possible applications for the X-ray Rayleigh scattering gage was conducted. Organizations interviewed were asked to consider problems of genuine import. Potential applications suggested for the gage included monitoring uranium waste solutions, determination of concentrations in alloys, homogeneity of ingots, and total fuel loading of U–Al fuel elements. Based on the survey, it appeared desirable to build at least one gage for the analysis of uranium alloys and one gage for monitoring waste solutions and disposable solids. (M.C.G.)

18079 TID-6109
National Lead Co. of Ohio, Cincinnati.
GAMMA GAGING IN CHEMICAL PLANT INSTRUMENTATION. J. A. Williamson and F. M. Teetzel. July 1958. 30p. OTS.

Various types of gamma radiation detection equipment were successfully applied to: (1) level indication of solids and powders, (2) level indication of a corrosive liquid in a large storage tank, (3) determination of solids flow characteristics in a large vertical reactor, and (4) measurement of density along the length of an extraction column. The various types of gamma radiation detectors and associated equipment used are compared, and their advantages and disadvantages are given. (auth)

18080
DETERMINATION OF THE MOISTURE CONTENT OF BUILDING MATERIALS BY GAMMASCOPY. Kernenergie 1, 224(1958) Mar. (In German)

A set-up for determining moisture in building materials is described which consists of a γ source, lead collimators, and a detector-counter. The natural background, the collimated beam without sample (I_0), the beam with dry sample (I_1), and the beam with moist sample (I_2) are measured. The results are calculated by the formula: $\ln I_1/I_0 - \ln I_2/I_0 = \mu(H_2O) \times d(H_2O)$, where μ = absorption coefficient and d = layer thickness. In experiments with concrete samples 100 mm thick and density 900 to 1100 kg/m^3, results compared with those obtained by weighing to within 2%. (T.R.H.)

18081
INVESTIGATION OF GLASS AND CERAMICS WITH THE AID OF RADIOACTIVE ISOTOPES. P. Bojovic and M. Ristic. Tehnika (Belgrade) 14, 285-8(1959). (Translated from Referat. Zhur. Khim. No. 23, 1959, abstract No. 82987).

Radioactive isotopes were employed as emanation sources and as indicators in the establishment of the reaction constants, in the investigation of certain ion diffusion rates in the glass, in the study of surface flow characteristics of glass masses contained in tub ovens, in the control of glazing application on ceramic objects, etc.

ISOTOPE SEPARATION

18082 KAPL-1249
Knolls Atomic Power Lab., Schenectady, N. Y.
THE SEPARATION OF HYDROGEN ISOTOPES BY SORPTION IN PALLADIUM. O. N. Salmon and F. K. Heumann. Jan. 19, 1955. Decl. Mar. 28, 1960. 29p. Contract W-31-109-Eng-52. OTS.

The separation of hydrogen and deuterium by use of palladium beds at room temperature was shown to be possible. The separation takes advantage of the differences in equilibrium concentrations and in the rates of sorption between the isotopes. The separation factors obtained using two palladium beds in series were between 4 and 5. This is in good agreement with theory. A scheme for hydrogen isotope separations by use of a countercurrent palladium bed is outlined. (auth)

18083 NP-tr-446
A KINETIC STUDY OF THE EXCHANGE OF DEUTERIUM BETWEEN LIQUID WATER AND GASEOUS HYDROGEN SULPHIDE. J. Garaud and R. Amanrich. Translated by M. H. Rand (U.K.A.E.A. Atomic Energy Research Establishment) from J. chim. phys. 56, 532-47(1959). 47p. (Handwritten MS. copy). JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 17887.

18084
SEPARATION AND UTILIZATION OF STABLE ISOTOPES. VII. SEPARATION OF STABLE ISOTOPES BY CHEMICAL EXCHANGE. PART I. Klaus Wetzel and Günter Kretzschmann (Institut für Physikalische Stoffternnung, Leipzig). Chem. Tech. (Berlin) 12, 263-6(1960) May. (In German)

The general principles of the chemical exchange processes are explained. The separation effect in isotope exchange reactions and multiplication of the elementary separation effect are discussed. (J.S.R.)

18085
SEPARATION OF ISOTOPE MIXTURE BY NOZZLE PROCESS. Hisashi Mikami and Yoshitoshi Ōyama (Tokyo Inst. of Tech.). J. Atomic Energy Soc. Japan 2, 291-5(1960) May. (In Japanese)

It was recently discovered by E. W. Becker et al. that an isotope gas mixture could be separated in a supersonic flow of jet. The separation may be due to pressure diffusion caused by a radial pressure gradient in the vicinity of the nozzle opening when the Knudsen number K_n is much smaller than 10^{-1}. On the other hand, when $K_n \gg 10^{-1}$, it may be explained in terms of free molecular effusion of the

gas mixture at the nozzle opening, but in an intermediate regime, $K_n \sim 10^{-1}$, theoretical treatment is difficult. The correlation of separation effect ϵ_A, and cut η was derived from the kinetic theory of gases on the assumption that the gas mixture effuses as free molecular flow at the nozzle opening. The calculated values were found to be in fairly good agreement with experimental data obtained by Becker et al. when the nozzle inlet pressure was maintained at 30 Torr. (auth)

18086

ISOTOPE SEPARATION BY THERMAL DIFFUSION IN LIQUID PHASE. K. F. Alexander (Zentralinstitut für Kernphysik, Dresden) and U. Krecker (Deutsche Akademie der Wissenschaften, Berlin). Kernenergie 1, 437-9(1958) June. (In German)

Using the Clusius and Dickel separation-tube process, the isotope effect in thermal diffusion in liquid butyl chloride and in liquid bromobenzene was studied. The thermal diffusion factors found in this study as well as those produced in other work are noticeably larger than those thermal diffusion factors expected in the gaseous phase. A comparison of the liquid and gas separations with respect to energy requirements and apparatus requirements leads to a general preference for the liquid process. (tr-auth)

18087

PRODUCTION OF A SELF-CASCADING AXIAL FLOW IN A LONG ULTRACENTRIFUGE FOR ISOTOPE SEPARATION. M. Steenbeck. Kernenergie 1, 921-8 (1958) Nov. (In German)

The principle of the Clusius-Dickel column is described, and an improvement offered. The Clusius-Dickel column is a centrifuge with self-cascading circulation flow due to a thermal gradient. The improved column uses braking disks. In this column, not only is the gas pressed to the wall more at the bottom, but also the angular velocity at the bottom is greater. At the upper end is a small circular-shaped brake disk which does not rotate. The operation of the column is explained in some detail, and a mathematical treatment is given. (T.R.H.)

18088

SOME PRELIMINARY INVESTIGATIONS BY MEANS OF GAS ADSORPTION ON SINTERED POROUS MEMBRANES FOR THE SEPARATION OF THE URANIUM ISOTOPES BY GASEOUS DIFFUSION. G. B. Lindström and M. Märtensson (Royal Inst. of Tech., Stockholm). Kolloid-Z. 169, 28-34(1960) Mar.-Apr. (In English)

An introductory investigation of the pore structure of a new type of porous membrane, manufactured by a new method, was performed. The membranes, suitable for the separation of the uranium isotopes by gaseous diffusion, are made of aluminum–aluminum nitride powder, obtained by sputtering in an electrical arc. The powder is deposited on a wire gauze, rolled, and sintered. By gas adsorption measurements, the pore radius distribution, the porosity, and the surface area were determined. An attempt was also made to calculate theoretically the permeability and the separation efficiency from the pore radius distribution curve. The influence of the sintering and the rolling pressure was studied, and corrosion studies of the membranes with UF_6 were performed. (auth)

18089

SEPARATION FACTORS OF BORON ISOTOPES IN THE EQUILIBRIUM VAPORIZATION OF BF_3. N. N. Sevryugova, O. V. Uvarov, and N. M. Zhavoronkov. Zhur. Fiz. Khim. 34, 1004-8(1960) May. (In Russian)

The temperature dependence of the isotope separation factor of boron in the equilibrium vaporization of BF_3 was determined at 157 to 168° by the Raleigh distillation method. An equation of the dependence is presented: $\alpha = 1.0488e^{-6.17/T}$. Within the above range of temperatures the volatile component is $B^{11}F_3$. (auth)

18090

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

MÉTODO GRÁFICO PARA DETERMINAR LA DISTRIBUCIÓN DE CONCENTRACIONES EN COLUMNAS DE DIFUSIÓN TÉRMICA. Informe No. 16. (Graphic Method for the Determination of the Distribution of Concentrations in Thermal Diffusion Columns. Report No. 16). Enrique Silberman and Carlos R. Carjuzaa. 1959. 7p.

The introduction of a "reduced length" permits the outline of a graph from which the distribution of concentration at equilibrium can be easily obtained for any thermal diffusion column. The method is particularly useful in the rapid obtention of data on the conditions along the length of the column and data on the initial concentrations. (J.S.R.)

18091

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

INFLUENCIA DEL RÉGIMEN NO LAMINAR SOBRE LA EFICIENCIA DE UNA COLUMNA DE DIFUSIÓN TÉRMICA. Informe No. 26. (Effect of Non-laminar Regime on the Efficiency of a Thermal Diffusion Column. Report No. 26). Carlos E. Español. 1960. 16p.

The effect of the appearance of localized perturbations on the separation factor and operation time of a thermal diffusion column is studied. The separation factor of a column was obtained experimentally and the enrichment was recorded continuously as a function of time by measurement of the thermal conductivity of the gaseous mixture at the foot and head of the column. A mixture of Ar and CO_2 was used as it behaves as an isotopic mixture. The results showed the linear decrease of the separation factor with the number of stages and the operation time practically does not vary. The introduction of localized turbulences in a thermal diffusion column reduces the column yield. (J.S.R.)

MATHEMATICS AND COMPUTERS

18092 ANL-6161

Argonne National Lab., Ill.

FORTRAN PROGRAMMING TECHNIQUES FOR GRAPH PLOTTING ON THE IBM-704 COMPUTER. Charles Erwin Cohn. May 1960. 19p. Contract W-31-109-eng-38. OTS.

The numerical results of the IBM-704 computer can be put into graphical form with the aid of the IBM-717 peripheral line printer, and programming techniques using FORTRAN II are described for the production of several kinds of graphs. Different symbols can be used, and a total of 100 horizontal spaces are available, giving a resolution of 1%. (D.L.C.)

18093 CF-60-3-129

Oak Ridge National Lab., Tenn.

POLFIT, A 704 PROGRAM FOR POLYNOMIAL LEAST SQUARES FITTING. M. H. Lietzke and Marjorie P. Lietzke. Mar. 31, 1960. 16p. OTS.

A polynomial least squares fitting subroutine was written for the IBM-704 computer. This subroutine

may be used in any Fortran II program where a least squares fit is desired. A calling program was written to do a polynomial least squares fit, error analysis, and give solutions of the resulting equations for any desired values of the independent variable. (auth)

18094 GEAP-3356
General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.
VARI—SOLUTION OF SIMULTANEOUS, FIRST-ORDER, ORDINARY, DIFFERENTIAL EQUATIONS. B. A. Kerr. Mar. 15, 1960. 23p. Contract AT(04-3)-189. OTS.

VARI solves on the IBM-650 a system of simultaneous, first-order, ordinary, differential equations of the form $dy_n/dt = \Sigma_i \Sigma_j y_i \alpha_{ij} (\delta_{j,n} - \delta_{i,n})$, $\delta_{n,n} = 1$, $\delta_{n,x} = 0$, where α_{ij}, the transfer coefficient from $y_i \rightarrow y_j$, is calculated by the program from the input constants: $\alpha_{ij} = (\sigma_{ij}\phi + \lambda_{ij})$. The maximum number of equations is twenty. The program was written to facilitate the calculation of composition changes in an absorbing sample which arise from long-term neutron bombardment. (auth)

18095 KAPL-M-JA-7
Knolls Atomic Power Lab., Schenectady, N. Y.
KARE GENERAL MESH DATA. J. A. Archibald, Jr. May 6, 1960. 25p. Contract W-31-109-Eng-52. OTS.

A listing was made of the General Mesh Data (GMD), the permanent memory of the computer during the running of a KARE life study. The numbers that it contained were used to control the running of the life study and the various options available within KARE. The entire GMD was formed at the beginning of the life study from phase 1 input. The initial version of KARE contained 250 words of General Mesh Data starting at location 2816_{10}. (M.C.G.)

18096 LA-2410
Los Alamos Scientific Lab., N. Mex.
THE STRUCTURE OF CERTAIN FINITE DIFFERENCE SCHEMES. Burton Wendroff. Mar. 1960. 11p. Contract W-7405-eng-36. OTS.

Difference schemes for obtaining approximate solutions of hyperbolic differential equations, using the notion of interpolation, are formulated. (auth)

18097 SCR-185
New Mexico. Univ., Albuquerque.
ON THE ALGEBRA OF BOUNDARY-VALUE PROBLEMS. Oswald Wyler. May 1960. 25p. For Sandia Corp. OTS.

The formation of boundary-value problems in the theory of differential equations, in terms of operators on functional spaces, brings a strong algebraic element into this theory. An endeavor is made to pursue a purely algebriac attack on the existence of suitable generalized inverse operators. Green's functions were used in the study of boundary-value problems of ordinary and partial differential equations. Green's function is the kernel of an integral operator with suitable properties. An introduction to weak topologies was included to introduce the notations best suited for this purpose. (B.O.G.)

18098
STOCHASTIC APPROXIMATION METHODS. Vaclav Fabian (Research Inst. for Mathematical Machines, Prague). Chekhoslov. Mat. Zhur. 10, 123-59(1960). (In English)

The methods are concerned with the problem of approximating a point of the q-dimensional Euclidian space at which a function f acquires its minimum or maximum or at which f is equal to a predetermined number. These methods are used to determine optimum conditions for concrete chemical and physical processes. Some modifications of known approximation procedures are considered, and general theorems are proven which make possible the study of their convergence. (B.O.G.)

18099
MATHEMATICS OF RELIABILITY. J. M. Wiesen (Sandia Corp., Albuquerque, N. Mex.). p.110-20 of "Proceedings Sixth National Symposium on Reliability and Quality Control in Electronics, January 11-13, 1960." New York, The Institute of Radio Engineers, Inc., 1960.

The mathematics of reliability is discussed in terms of probability, probability distributions and their characteristics, estimation, and tests of hypotheses. Applications to the exponential distribution are indicated. (auth)

18100
THE PRACTICALITY OF PREDICTING RELIABILITY NUMBERS. William E. Boyes (Sandia Corp., Albuquerque, N. Mex.). p.282-5 of "Proceedings Sixth National Symposium on Reliability and Quality Control in Electronics, January 11-13, 1960." New York, The Institute of Radio Engineers, Inc., 1960.

Reliability is considered as a problem in prediction with a philosophy and simple model being offered. In particular, the need for establishing the correlation or degree of simulation between any test used as a reliability predictor and the ultimate use is described. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

18101 AECL-990(Paper 11)
Canadian Westinghouse Co., Ltd. Atomic Energy Div., Hamilton, Ont.
PROBLEMS IN NUCLEAR EQUIPMENT DESIGN AND MANUFACTURE. S. M. Jones. Paper 11 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 15p.

Four representative problems in the design and manufacture of nuclear equipment are discussed: fabrication of a heavy-walled stainless steel vessel for the E-20 loop; design and manufacture of mechanical joints between Zircaloy-2 and stainless steel; determination of the mechanical properties of hydrided Zircaloy foil; and the production of a Zr–Be brazing alloy powder. (W.D.M.)

18102 AMC-TR-59-7-579
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
DEVELOPMENT OF HIGH TEMPERATURE DIE MATERIALS (HOT DIE MATERIALS). Final Technical Engineering Report [for] October 15, 1957 to June 15, 1959. H. R. Nichols, W. H. Graft, V. Pulsifer, and P. R. Gouwens. 133p. AMC Project 7-579. Contract AF33 (600)-35914. (AD-232717). OTS.

Precision, thin-walled, high-strength steel forgings for high performance aircraft and missiles can be quickly and economically forged in hot dies of Inconel 713-C using a potassium iodide-graphite lubricant-parting agent. The nickel-base casting alloy, (Inconel 713-C) was superior to a cobalt-base alloy (HE 1049) and four other basic alloy families in oxidation resistance, hot strength stability on aging, hot wear resistance, and compressive deformation strength at temperatures as high as 1600°F. The four

other alloy families were ferritic, Fe-Co-W; austenitic, Fe-Cr-W-Ni; austenitic with vanadium, niobium, or tungsten carbide; and a superlattice aluminum-bearing austenite. A lubricant-parting agent, powdered potassium iodide and graphite in a ratio of 1:2, increased forging reduction and permitted metal flow at the die-work interface at die temperatures up to 1600°F. Approximately 200 test forgings of one-half of an H-beam section were produced which had a projected area of 25 square inches, including flash. Marked increases in die filling took place as the die temperature increased from 300 to 1600°F. (auth)

18103 BAW-1192

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

LIQUID METAL FUEL REACTOR EXPERIMENT. OPERATION AND TESTING OF A NONNUCLEAR LIQUID-METAL SYSTEM. May 1960. 139p. Contract AT(30-1)-1940. OTS.

The operation and testing of a bismuth-to-bismuth dual-loop system, known as the Four Inch Utility Test Loop, are discussed. The stability of uranium, magnesium, and zirconium in a bismuth system was tested. The steady state and transient characteristics of the individual components and the over-all system were determined by manually introducing load disturbances and by using a plant control system. Operation and testing of the Four Inch Loop revealed that such a nonnuclear system is feasible, and that it provides a practical means for producing large quantities of thermal energy. (auth)

18104 BMI-1330

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MARCH 1959. Russell W. Dayton and Clyde R. Tipton, Jr. Apr. 1, 1959. Decl. June 12, 1959. 90p. Contract W-7405-eng-92. OTS.

In the program on the use of radioisotopes for quality control in the cement industry, experiments were performed on the determination of Ca by EDTA titration using a radiometric endpoint, on sulfur analysis by radiometric endpoint, and on sulfur analysis by radiometric titration with Ba^{140} as $BaCl_2$. Work on the survey and evaluation of various industrial processes which might utilize intrinsic radioisotopes in process control was completed. A study of the solidification of U cast in cylindrical graphite molds is being made. Studies aimed at reducing the amount of additive needed to stabilize UO_2 were continued. The irradiation history of a 2 wt.% U–Zr alloy hydride capsule is reported. Investigation of the changes in the mechanical properties of AISI Type 347 stainless steel as affected by exposure to fast neutron flux is being conducted. The evaluation of selected Nb-base alloys for possible service in pressurized-water reactors was continued. A program to investigate the friction and wear behavior of rubbing surfaces lubricated by high-temperature sodium was initiated. A study of the fabrication characteristics and the mechanical and physical properties of Nb-rich U alloys is being made. Thorium–uranium alloys are being investigated with the objective of improving corrosion resistance and irradiation stability by means of alloying and control of processing variables. A research program to develop a physical model and mathematical theory to describe the release of fission gases from sintered fuel materials is reported. Techniques for producing cermets of 90% of theoretical density or better containing 60 to 90 vol.% fuel dispersed in a metal matrix are being investigated. A gas-pressure-bonding process is being investigated as a method of cladding of ceramic- and cermet-type fuels with Mo and Nb. The effects of forming pressure and initial particle size on the porosity and grain size of UC compacts sintered at 1600°C for 1 hr are reported. Work was continued on the post-irradiation study of fission-gas release from UO_2–graphite spheres at elevated temperatures. The evaluation of materials of construction for the Darex, Sulfex-Thorex, Darex-Thorex, Zirfex, and Fluoride Volatility processes was continued. The irradiation of capsules containing UC specimens is continuing. Data are presented on the fabricability and hardness of binary Ta alloys. (For preceding period see BMI-1324). (W.L.H.)

18105 BMI-1366

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JULY 1959. Russell W. Dayton and Clyde R. Tipton, Jr. Aug. 1, 1959. Decl. Feb. 4, 1960. 100p. Contract W-7405-eng-92. OTS.

A study of the creep properties of 15% cold-worked and annealed Zircaloy-2 sheet at 290, 345, and 400°C is continuing. Data are presented on the corrosion in high-temperature water of defected natural-U fuel cores extrusion clad with Zircaloy-2. The composition and temperature of the Al–U–Ni ternary eutectic in high-Al alloys are being determined. The study of neutron-activation analysis of cement raw materials was continued. Work continued on the study of radiation-induced changes in polymers leading to graft copolymerization. Work continued on the determination of valence effects of La_2O_3, Y_2O_3, and CaO additions to UO_2. An investigation is being made of the effects of combined high pressure and high temperature on reactions of uranium oxide with various mixed oxides. A program is in progress to determine the effect of irradiation on the mechanical properties of AISI Type 347 stainless steel. A summary is presented of corrosion results obtained on Nb alloys exposed in high temperature water and steam. An investigation of the creep properties of Zircaloy-2 during irradiation at elevated temperatures continued. The properties of Nb-rich Nb–U alloys are being investigated. A program to develop Th–U-base alloys of improved radiation stability by ternary and quaternary alloying is in progress. Cermet fuel materials consisting of from 60 to 90 vol.% UO_2 dispersed in Cr, Mo, Nb, or stainless steel matrices are being investigated. Work continued on the gas-pressure bonding of Mo- and Nb-clad fuel elements. Cold-compacting studies were made with several grades of commercial UO_2 powder and results are reported. Fabrication of UC by various methods are reported. The rates of diffusion of U and C in UC are being investigated. The migration of hydrogen in Zr under the influence of a thermal gradient is being examined. Spherical fueled-graphite elements are being evaluated in preirradiation tests. Data are reported on the fabricability and hardness of binary Ta alloys. Techniques were developed to coat by vapor deposition of Cr or pyrolytic carbon both blasted and unblasted UO_2 cores. Investigations have continued on the fabrication of Zircaloy-2–clad compartmented UO_2 fuel elements by gas-pressure bonding. Densely-sintered matrices of BeO containing about 20 vol.% of uniformly dispersed UO_2 particles are being investigated for fuel-element-core applications. Techniques for cladding UO_2 particles with impermeable shells of BeO are being developed. Data are reported on fission-gas release from UC_2–graphite and BeO–UO_2 specimens heated in vacuum at 1800°F for 24 hours. An investigation is being conducted to develop fuel, absorber, and suppressor materials for the SM-2. Progress of capsule-irradiation programs is reported for stainless steel–UO_2 and–UN dispersion fuel elements, solid

UO_2 and annularly loaded UO_2 fuel pins, and graphite–UO_2 fuel bodies. (W.L.H.)

18106 BMI-1409

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY 1960. Russell W. Dayton and Clyde R. Tipton, Jr. Feb. 1, 1960. Decl. Apr. 20, 1960. 88p. Contract W-7405-eng-92. OTS.

Solid-state studies of oxide additions to uranium oxides are being conducted in correlation with the high-temperature stability and physical properties of these solid solutions. The program to determine the effects of fast neutron irradiation on properties of AISI Type 347 stainless steel has continued. Cladding materials being studied for possible use in the EBR are unalloyed Nb, Nb–Cr, Nb–Zr, and Nb–Ti–Cr. The evaluation of selected Nb alloys for possible service in pressurized-water reactors was continued. The creep strength of Zircaloy-2 at elevated temperature is to be determined and compared for two test conditions: in-reactor under a fast neutron flux and out-of-reactor. A study is being made of new approaches to the problem of measuring the oxygen content of sodium. The development of Nb-rich Nb–U alloys as high-temperature fuels is reported. Development of Th–U-base alloys with improved radiation stability and corrosion resistance continued. Results of various studies designed to support experiments of fission-gas release from UO_2 during and after irradiation are reported. Cermets of 80 vol.% UO_2 dispersed in stainless steel, Mo, Cr, and Nb are currently being fabricated by pressure-bonding techniques for physical and mechanical testing. An investigation is being made of the mechanism and kinetics of solid-phase bonding of metals under application of heat and pressure. Various methods of preparing UC powder and dense UC bodies by powder-metallurgy techniques are being investigated. Reliable techniques for the production of high-quality cast shapes of UC are being developed. An investigation of the effects of fission and irradiation on the structure and physical properties of UC is in progress. Research was continued on the problem of growing large single crystals of UO_2 by fusion methods. A basic study of the migration of hydrogen in zirconium under the influence of a thermal gradient is being conducted. Work was continued on the determination of Fe in portland cement by means of a complexometric titration with a radiometric end point. The long-term program for determining the creep and stress-rupture properties of Zircaloy-2 sheet material has continued. Investigations on the development of a fuel-element leak detector have continued. Self-welded specimens of the 12 experimental alloys and unwelded specimens of vacuum-metal Hastelloy F were exposed to boiling Sulfex and Niflex solutions for five 24-hr periods. Previous experience with Al–35 wt.% U alloy has shown that improvements in casting and fabricating characteristics can be obtained when suitable ternary additions are used. The effects of impurities present in commerical-grade materials on the ternary eutectic temperature of Al–U–Ni alloy are being investigated. A program is currently being conducted to determine the changes induced in the properties of UC by irradiation in a test reactor. Work continued on the development of Al_2O_3-clad UO_2 fuel particles. Data are presented on the room-temperature tensile properties of unirradiated and irradiated Ta. Ceramic-type fuels composed of ~20 vol.% UO_2 in BeO, 20 vol.% UO_2 in Al_2O_3, 20 vol.% UC in graphite, and 20 vol.% UC_2 in graphite are being considered as potential fuels for the MGCR. Reference materials were selected and fabrication techniques are being evaluated for use in preparing fuel plates and absorber plates for the SM-2 reactor. Pellets of BeO–25 vol.% UO_2 are being prepared for loop and capsule exposures. (For preceding period see BMI-1403.) (W.L.H.)

18107 BMI-1441

Battelle Memorial Inst., Columbus, Ohio.

AN EVALUATION OF DATA ON NUCLEAR CARBIDES. Frank A. Rough and Walston Chubb, eds. May 31, 1960. 102p. Contract W-7405-eng-92. OTS.

Data on the properties, constitution, compatibility, radiation behavior, fabrication, preparation, storage, and handling of uranium, thorium, and plutonium carbides are reviewed. 187 references. (C.J.G.)

18108 BMI-1444

Battelle Memorial Inst., Columbus, Ohio.

APPARATUS FOR THE STUDY OF FISSION-GAS RELEASE FROM NEUTRON-ACTIVATED FUELED GRAPHITE. Harvey S. Rosenberg, Robert Lieberman, Duane N. Sunderman, and Ward S. Diethorn. June 7, 1960. 10p. Contract W-7405-eng-92. OTS.

A simple laboratory apparatus for the study of fission-gas release from neutron-activated fueled graphite was developed. Xenon-133 released from a heated specimen is carried in a helium sweep gas to a charcoal trap, where the accumulated activity is monitored continuously by a scintillation detector, ratemeter, and pen recorder. The maximum specimen temperature (2500°F) is achieved in 10 min with an induction heater. All instrumentation is commercially available. Data for several neutron-activated fueled-graphite specimens heated in the range from 800 to 2500°F are presented to illustrate the typical results obtained with the apparatus. (auth)

18109 HW-57343

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM FUELS DEVELOPMENT, PLUTONIUM METALLURGY OPERATION QUARTERLY REPORT–JANUARY, FEBRUARY, MARCH 1958. O. J. Wick. Sept. 4, 1958. 25p. Contract W-31-109-Eng-52. OTS.

The last two of four Zircaloy-clad capsules containing aluminum–plutonium and aluminum–silicon–plutonium were discharged from the MTR and are undergoing examination. These capsules withstood a fractional burnout of plutonium atoms of 55 to 60% as determined by flux monitoring wires attached to the capsule holder. Additional capsules of these fuel alloys containing a higher concentration of plutonium are being fabricated. Concentrations of 5, 10, 15, and 20 wt.% plutonium alloyed with aluminum and aluminum–12 wt.% silicon will be irradiated to determine the upper limits of plutonium concentration before dimensional instability or swelling becomes a problem. Work is continuing on four rod clusters containing Al–8 wt.% Pu and Al–12 wt.% Si–8 wt.% Pu alloy cores in Zircaloy jackets. These clusters will be irradiated in the high temperature (250°C) KER loop facility. Corrosion properties of the Zircaloy tubing in end cap welds are being evaluated in out-of-pile loops utilizing Zircaloy-clad Al rods as stand-ins. The corrosion behavior of several U–Al and U–Al–Si alloys in high-temperature water was investigated. Uranium alloys were being used in place of Pu alloys for this preliminary investigation because high-temperature autoclaves mounted in hoods are not available. Results indicated good corrosion resistance of alloys containing Si and of as-cast 6 wt.% U–Al alloy. Some room-temperature mechanical and physical properties of Al–Pu alloys containing 2 to 12 wt.% Pu were determined. The ultimate and yield strengths, hardness, and density data are presented for these alloys. Pyrometallurgical tech-

niques are being investigated as a means of reconstituting irradiated Pu fuel materials. Liquation experiments were performed on Al–Pu–Si alloys with inconsistent results. The object of this experiment was to separate a Pu bearing phase from the principal alloying element. In another experiment 80% of the Pu in 400 grams of 10 wt.% Pu–Al alloy was extracted in the molten state with bismuth. Work on injection casting of molten Al–Pu alloy directly into Zircaloy tubes is continuing utilizing air pressure and mechanical injection casting methods. Cast densities on the order of 97% of theoretical were obtained, utilizing each of these methods for injection of aluminum into stainless steel tubes seven to eight feet long. Hooded injection equipment is being designed for application of these techniques to Al–Pu alloy fuel materials. Substitute techniques were worked out for fabrication of injection cast Al–Pu capsules for MTR evaluation. An improved design for the 19 rod cluster fuel element was made which incorporates several new features. This design will result in a cost saving of approximately 25% over prior designs. Parts for two clusters were fabricated and will be utilized for hydraulic testing and other engineering tests. Thermal-cycling tests were performed on an NPD design Mark-I element in the Elmo-7 loop. This 19 rod stainless steel clad aluminum core cluster was cycled 143 times at 550°F. The cluster showed no evidence of thermal distortion, elongationing or loosening of the spiral spacer wires. Work is continuing on the U–Pu test pieces requested by Nuclear Physics Research Operation for evaluation in the PCTR. All the U–Pu alloy slugs simulating burnups of 1000 and 2000 Mwd have been fabricated and shipped. Work is continuing on the 4000 Mwd alloy. (For preceding period see HW-55415.) (auth)

18110 HW-59365

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM FUELS DEVELOPMENT, PLUTONIUM METALLURGY OPERATION QUARTERLY REPORT–JULY, AUGUST, SEPTEMBER 1958. O. J. Wick. Feb. 24, 1959. 26p. Contract W-31-109-Eng-52. OTS.

Examination of Al–1.65 wt.% Pu and Al–12 wt.% Si–1.65 wt.% Pu capsules irradiated 55 to 60% burnout of the Pu atoms revealed a 1.4% vol. increase and no apparent microstructural change. A four rod cluster containing Al–8 wt.% Pu and Al–12 wt.% Si–8 wt.% Pu alloy cores is currently under irradiation at a water temperature of ~230°C. Development of pyrometallurgical reprocessing techniques for Pu–Al alloys has continued. Injection cast Pu–Al irradiation capsules were fabricated by a process utilizing existing equipment. Development of pressure die casting techniques is continuing. Extrusion studies were performed with a number of Al alloys as studies for Pu–Al. Sintering studies are being conducted on a variety of UO_2–PuO_2 compositions composed of both mechanically mixed oxides and co-precipitated oxides diluted mechanically with UO_2. Engineering studies on 19-rod cluster elements have resulted in improvements in design and simplification of fabrication techniques. Welded closures were effected on Zircaloy-2 clad Pu–Al alloy fuel rods in the vacuum welding box. (W.L.H.)

18111 IS-17

Ames Lab., Ames, Iowa.

ANNUAL SUMMARY RESEARCH REPORT IN METALLURGY FOR JULY 1958–JUNE 1959. Nov. 1959. 138p. Contract W-7405-eng-82. OTS.

Separation Studies. The work on liquid-liquid extraction as a means for purifying inorganic materials of interest in pure metal preparation was continued. The distribution of Pa^{233} in the pyrometallurgical separation of uranium from uranium–thorium alloys was investigated. Work has continued on the separation of minor constituents from uranium by selective oxidation or reduction reactions utilizing liquid zinc and KCl–LiCl eutectic as solvents, $ZnCl_2$ as oxidizing agent, and magnesium or calcium as reducing agents. The distribution of Mo, Zr, Cr, and U between KCl–LiCl eutectic containing excess $ZnCl_2$ and Zn was studied. To study the effectiveness of a Zn-rich Mg or Ca alloy in reducing Pa^{233} from the salt phase, samples were equilibrated at 700°C with a Zn phase containing 2 to 4 wt. % Ca or Mg or both. The possibility of precipitating solutes as hydrides from liquid-metal solvents by contacting the solutions with hydrogen at one atmosphere pressure is being investigated. Preparation of Pure Compounds. Work on the preparation of high-purity V_2O_5, as one phase of a program for the preparation of high-purity V compounds, was completed. Work on the large-scale preparation of YF_3 was continued. Metal Preparation and Purification Studies. The purification of V by the iodide process is being investigated. Work was continued on the preparation of Nb by the reduction of Nb_2O_5 with carbon. Investigation of the purification of Nb metal by the iodide process has continued with extension of feed metal temperatures to 800°C. As a result of the mixtures of Nb and NbI_3 which were obtained from the iodide process feed metal, a method was sought for recovery of the metal for reuse in the iodide purification. A Pyrex apparatus for the purification of Th by the iodide process was used to supply small research quantities of the metal. The development of the Mg reduction of $ThCl_4$ as a method of preparing high-purity Th is being investigated. Work is presented in the preparation of high-purity Y. Several different approaches were tried in attempts to remove oxygen from Y metal or to prevent the introduction of oxygen in processing. The work on the carbon reduction of UO_2 toward increased yield and reduced carbon content of the metal has met with only limited success. The method of producing high-purity Ta by the carbon reduction of tantalum pentoxide at high temperature in a vacuum is being studied in some detail. The purification of Ca and Li by vacuum sublimation and distillation is reported. Alloy Investigations. Experimental determinations of the Th content in liquid Zn equilibrated with an excess of solid Th_2Zn_{17} at various temperatures was completed. The vapor pressure of Zn over two-phase alloys consisting of Th–Th_2Zn, Th_2Zn–$ThZn_2$, $ThZn_2$–$ThZn_4$, and $ThZn_4$–Th_2Zn_{17} was measured as a function of temperature by the dew-point method. Crystal structures and thermodynamic properties of the compounds in the Th–Zn system were investigated. The U–Re system is being investigated by various standard techniques. The investigation of the solubility limits of the Th–Mo system is being continued. Crystallographic and phase relationships of the Ni–Zr and Ni–Hf alloys are being investigated. The basic process used to prepare Nb–Al alloys is reported. Tensile properties are reported for some Al-rich Al–Nb alloys. Phase studies are presented for the Co–Zr alloy. The magnesium vapor pressures over Mg–Cu and Mg–Ni alloys were measured for various compositions by the Knudsen effusion method in the temperature range 400 to 1100°K. Solid State Investigations. Thermal expansion in single crystals of Y, Be, and Zn was measured both parallel and perpendicular to the unique axis. Measurement of five independent elastic constants of single crystalline Be was completed. The crystal structure of the intermetallic compound U_2Zn_{17} was determined. The tensile properties of V

were determined with and without hydrogen addition. Bend tests were employed as a method of determining the temperature dependence of the ductility of Nb–V binary alloys. The reaction of $VOCl_3$ with hydrogen was performed at temperatures from 500 to 850°C. (W.L.H.)

18112 LA-2345
Los Alamos Scientific Lab., N. Mex.
COMPILATION OF CALCULATED DATA USEFUL IN PREDICTING METALLURGICAL BEHAVIOR OF THE ELEMENTS IN BINARY ALLOY SYSTEMS. E. Teatum, K. Gschneidner, Jr., and J. Waber. Aug. 1959. 222p. Contract W-7405-eng-36. OTS.

Physicometallurgical data were computed for all the binary combinations of elements in the periodic table with the exception of the halogens, rare gases, and those elements having higher atomic numbers than that of americium. Brief descriptions are given of the formulas for the following quantities: the radius ratio, the sublimation energy ratio, the Mott bonding number, the Hildebrand or heat of mixing factor, and the electronegativity difference. Some possible uses of these quantities are also described. The sources of data selected for these calculations and the arrangement of the tables are discussed. (auth)

18113 LAMS-2401(Vol.2)
Los Alamos Scientific Lab., N. Mex.
BIBLIOGRAPHY ON TUNGSTEN, ITS ALLOYS AND COMPOUNDS. Lois E. Godfrey, Patricia E. Bell, and Helen S. Stearns, comps. July 1959. 223p. Contract W-7405-eng-36. OTS.

A bibliography of 2524 references is given on tungsten, its alloys, and compounds. The references are divided into sections on the basis of whether they are general or deal with the preparation and properties of the substances. (D.L.C.)

18114 NYO-4836
Massachusetts Inst. of Tech., Cambridge.
X-RAY MEASUREMENT OF GRAIN SIZE. B. E. Warren. June 1960. 7p. Contract AT(30-1)-858. OTS.

When the number of crystals contributing to a powder pattern peak is small, changes in the position and orientation of the sample produce statistical variations in the measured integrated intensity. The statistics are those of a Poisson distribution, and the effect can be utilized in a very simple way for an absolute determination of grain size. Only relative intensity measurements are required. Grain sizes down to about one or two microns can be measured by this method. There is an interesting possibility of varying the experimental conditions in such a way as to distinguish between the sizes of grains and subgrains. (auth)

18115 ORNL-1437(Del.)
Oak Ridge National Lab., Tenn.
METALLURGY DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1952. W. H. Bridges, ed. Decl. with deletions Oct. 29, 1959. 48p. Contract W-7405-eng-26. OTS.

Physical Metallurgy. In the study of Th alloys, it has been found that the addition of Nb and V to Th produces a slight strengthening effect with the first small additions, but that large additions result in a lowering of strength with corresponding increases in ductility. The melting point of iodide Th was measured as being 1755°C. Studies of a series of Th–C alloys, with C content up to 0.13%, indicate that C does not affect the temperatures for the start and completion of recrystallization. ANP Program. Welding specifications were prepared for the joining of Inconel pipe and fittings for use with highly corrosive media. The production of spherical particles of alloys of U with Ni, V, Nb, and Mo is being studied. The effect of small differences in test temperature in the stress-rupture life and creep rate of Inconel was studied. The effect of different cleaning procedures on the corrosive action of the fluorides on Inconel is being studied. Additional static and dynamic tests were run in an attempt to find inhibitors for the mass transfer and corrosion exhibited in the metal-hydroxide systems. The study of the compounds formed by the interaction of Ni in the hydroxides has shown the appearance of two new compounds: $NaNiO_2$ and $LiNiO_2$. Ceramics Research. A ceramic coating was successfully applied to Ni, and a Ni radiator assembly is being coated for the ANP Project. A technique for the synthesis of hafnium carbide was developed. Fabrication Research. Production of enriched U fuel and control rod elements for operation of the MTR is described. (W.L.H.)

18116 SCNC-306
Sylvania-Corning Nuclear Corp., Bayside, N. Y.
QUARTERLY TECHNICAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1959. Feb. 1960. Decl. Mar. 14, 1960. 23p. Contract AT-30-1-GEN-366. OTS.

Work on the fabrication of ceramic fuel elements by isostatic pressing was directed at improving the density of the hot isostatically pressed, fused UO_2 compacts, and determining the changes in the structure of the cladding due to hot isostatic pressing. Attempts to prepare dense samples for thermal conductivity tests, using 92 M % UO_2–8 M % Y_2O_3 rather than 96 M % UO_2–4 M % Y_2O_3 as in previous period, were unsuccessful. Attempts to standardize the thermal conductivity furnaces with three UO_2 samples are still unsuccessful. Work was continued on the determination of the behavior of stainless steel-clad, isostatically pressed oxide samples relative to that of standard, pelletized UO_2, under prolonged neutron irradiation. Work has started on the determination of the dimensional stability of U–Y alloys under neutron irradiation at high temperatures. (For preceding period see SCNC-303.). (W.L.H.)

18117 TID-6101
Horizons, Inc., Cleveland.
INVESTIGATION OF ELECTROLYTIC PROCESSES FOR PREPARATION OF HIGH PURITY NIOBIUM METAL. A. J. Kolk, Jr., M. E. Sibert, and M. A. Steinberg. [1960?]. 26p. Contract AT(30-1)-1894. OTS.

An investigation of the electrolytic preparation of niobium by fused salt electrolysis was conducted along two lines. One approach comprised the direct electrolysis of molten K_2NbF_7-alkali halide mixtures using an inert graphite anode. High purity, cold-ductile metal was produced by this type of electrolysis under a variety of experimental conditions. A second process which was investigated is the electrorefining of an impure niobium, prepared by a high-vacuum, high-temperature reaction of the pentoxide (Nb_2O_5) with carbon. In the investigation of the electrorefining phase, difficulty was experienced with oxygen being carried over to the cathode deposit; however, other nonmetallic impurities were successfully eliminated by this procedure. (auth)

18118 TID-7589
Battelle Memorial Inst., Columbus, Ohio.
PROGRESS IN CARBIDE FUELS. NOTES FROM THE SECOND AEC URANIUM CARBIDE MEETING, HELD AT

BATTELLE MEMORIAL INSTITUTE, MARCH 22 AND 23, 1960. Apr. 20, 1960. 94p. Contract W-7405-eng-92. OTS.

A summary is given of the information presented at the Second AEC Uranium Carbide Meeting on March 22 and 23, 1960, at Battelle Memorial Institute. It consists of a collection of notes prepared by the participants to provide background information for the discussions of the work being carried out by the participating laboratories and is not a transcript of the proceedings of the meeting. (B.O.G.)

18119 USBM-U-699

Bureau of Mines. Albany Metallurgy Research Center, Ore. QUARTERLY METALLURGICAL PROGRESS REPORT NO. 6 FOR THE PERIOD OF JANUARY 1, 1960 TO MARCH 31, 1960. 23p. Contract AT(11-1)-599. OTS.

Yttrium research was largely directed toward the development of methods for the preparation of high-purity YBr_3 and the subsequent reduction of this compound by active metals. Fabrication studies were continued to determine further the working characteristics of high-purity Y. The small fluidized-bed reactor was completed and testing was started. Two different types of reduction of UF_6 were investigated: the high-temperature Ca reduction at 1200°C and the Mg at 900°C. Two methods of separating Zr and Hf and preparing a Hf-rich concentrate were investigated. Hafnium metal exhibiting Rockwell A harnesses comparable to crystal-bar purified metal was prepared by the magnesium reduction of chlorine-treated $HfCl_4$. The development of Hf–Ta alloys has continued. The investigation of the pseudo-binary stainless steel–gadolinium phase diagram was continued. (For preceding period see USBM-U-672.) (W.L.H.)

18120 AEC-tr-4101

DIAMOND TOOLS. H. C. B. Kleinschmidt. Translated from Metall 14, 25-36(1960). 25p. JCL.

A discussion is given of the technical application of diamonds in industry. Industrial diamonds (borts) are used in finish-machining procedures-fine grinding, lapping, and polishing. These procedures are used to enhance the quality of the product, improve shape precision and fit of the piece, reduce abrasion wear, give better tolerances, and prolong component life. Binders used in diamond grinding wheels are cemented carbides, plastics, and metals such as steel, bronze, and nickel. There are four applications of diamonds which are prominent: (a) raw diamonds to be set in tools; (b) cut diamonds; (c) powder in loose form; and (d) bound powder in grinding wheels. The usage and care of various types of dressing tools utilizing diamonds are discussed. Some characteristics and applications of boron carbide (Tetrabor, B_4C) are discussed pertaining to its compatibility with diamonds as an industrial tool. (B.O.G.)

18121

DETERMINATION BY ELECTRON MICROGRAPHY OF THE DISTRIBUTION OF THE OXIDE IN FRITTED BERYLLIUM. Adrien Saulnier and Paul Mirand. Compt. rend. 250, 3834-5(1960) June 8. (In French)

Two methods were developed for the electron micrographic examination of the oxide distribution in fritted Be. One method is based on the extraction of the oxide particles with a surface replica and the other is a direct observation of thin metallic sections. The replica method shows that when the grain is only 40μ, there exist in the powder very fine flakes which are completely oxidized. If the average grain is 80μ, the oxide is found in the form of particles with mean dimensions of the order of 1/10 micron. Analogous results were obtained with direct electron micrography. The direct method has the advantage of showing dislocations of the metal and their interaction with the oxide particles. (J.S.R.)

18122

SOME NUCLEAR ENGINEERING PROBLEMS ON CONSTRUCTION MATERIALS. Fritz Thümmler. p.43-59 of "Das Zentralinstitut für Kernphysik am Beginn Seiner Arbeit." Heinz Barwich, ed. Berlin, Akademie-Verlag, 1958. 59p. (In German)

The properties and behavior of uranium, aluminum, and zirconium and their alloys and compounds of significance in reactor construction are reviewed. The radiation effects are indicated by a few examples. (J.S.R.)

Corrosion

18123 AECD-4292

Oak Ridge Gaseous Diffusion Plant, Tenn. HIGH TEMPERATURE CORROSION STUDY INTERIM REPORT FOR THE PERIOD NOVEMBER 1958 THROUGH MAY 1959. C. F. Hale, E. J. Barber, H. A. Bernhardt, and Karl E. Rapp. July 28, 1959. Decl. Oct. 22, 1959. 39p. OTS.

This is a corrected version of an earlier report prepared as KL-498.

Samples of grade A Monel and grade A nickel were subjected statically in a single reactor to an undiluted atmosphere of gaseous fluorine at pressures up to one atmosphere absolute and temperatures up to 1500°F. The grade A Monel was conservatively estimated to have consumed at least 40 times as much fluorine as grade A nickel during the entire period of the investigation. Samples of fused α-Al_2O_3, α-Al_2O_3–MgO spinel, and α-Al_2O_3–NiO–nickel cermet were exposed to undiluted fluorine at one atmosphere absolute pressure at temperatures of 1340 and 1500°F. Results indicated that the α-Al_2O_3 is as good as the Ni in the region of 1300°F. Grade A nickel samples coated with nickel fluoride films of 37,000 and 74,000 A, respectively, were exposed to an absolute pressure of gaseous UF_6 of 12 cm of Hg at temperatures of 1000 and 1800°F. (W.L.H.)

18124 NMI-1217

Nuclear Metals, Inc., Concord, Mass. DIFFUSION ANNEALING AS A MEANS OF IMPROVING CORROSION RESISTANCE OF ZIRCALOY-2 CLAD, URANIUM-2 w/o ZIRCONIUM RODS. R. G. Jenkins. Apr. 11, 1960. 70p. Contract AT(30-1)-1565. OTS.

The diffusion heat treatment technique was investigated as a means of improving the corrosion protection provided by Zircaloy cladding coextruded with rods of U–2 wt.% Zr alloy. Specimens with cladding defects in the form of drilled holes were tested in high temperature steam and water to determine the effects of various factors influencing the beneficial effect of the diffusion anneal. These included heat treatment time and temperature, cooling rates, secondary heat treatments, defect size, cladding thickness, hardness, bond strength, and radiation. Most of these factors appeared to affect the ultimate corrosion life of the defected specimens. In particular, all heat treatments from 800 to 1050°C greatly increased the corrosion life if the time at temperature was sufficient; slow cooling rates or subsequent heat treatments between 650 and 700°C were detrimental; a strong initial bond is desirable; the treatment does not reliably provide protection if the cladding is 10 mils thick or less. A few defected, some irradiated specimens survived subsequent short-time corrosion tests. Tests were also performed on specimens with defects resulting from flaws placed in the cladding component prior to extrusion. Most of these specimens did not benefit from

the diffusion anneal. The treatment was successful, however, in preventing the failure of specimens with threads of uranium extending between the core material and the exposed cladding surface. The diffusion anneal technique continues to show promise as a means of increasing the reliability of the Zircaloy cladding on rods of U–2 wt.% Zr. (auth)

18125 NMI-1233
Nuclear Metals, Inc., Concord, Mass.
INTERDIFFUSION IN ZIRCALOY-2 CLAD U-2 w/o Zr FUEL MATERIALS AND ITS EFFECT UPON CORROSION BEHAVIOR. A. L. Geary. Mar. 24, 1960. 27p. Contract AT(30-1)-1565. OTS.

Properties of the interdiffusion zone in Zircaloy-2 clad U–2 wt.% Zr fuel materials were investigated and the results correlated with the corrosion behavior of defected specimens in high-temperature water. Electron microprobe and metallographic examinations of the zones were carried out, as well as corrosion studies on specimens annealed after the diffusion treatment. The results indicate that the beneficial effect of the diffusion treatment upon the corrosion behavior of defected specimens results from improved strength properties of the bond zone. During corrosion, the combined strengths of the zone and Zircaloy-2 cladding are great enough to compact the oxide corrosion product at the base of the defect, the compacted oxide inhibiting further attack. The formation of equilibrium alpha uranium in the inner portion of the zone must, however, be minimized in order to achieve the effect of the diffusion treatment. (auth)

18126 RIA-58-2834
Rock Island Arsenal Lab., Ill.
VCI BIBLIOGRAPHY AND ABSTRACTS. Ralph L. LeMar. Oct. 16, 1958. 115p. DA Project 593-21-055.

A bibliography relative to volatile corrosion inhibitors (VCI) covering published information from 1937 to 1957 was prepared. Most references were abstracted and these abstracts are included. The literature was divided into six sections for presentation. (auth)

18127 WAPD-MDM-2(Rev.)
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
AN EVALUATION OF THE SULFURIC ACID–SODIUM NITRITE ETCH FOR ZIRCALOY-2. Stanley Kass. Feb. 17, 1954. Decl. Feb. 16, 1960. 11p. Contract AT-11-1-GEN-14. OTS.

Preliminary experiments indicate that there are no significant differences in the corrosion rates of zirconium or Zircaloy-2 after etching with the nitric–hydrofluoric solution or the sulfuric–nitrite solution, provided proper etching and washing techniques are followed. Incomplete removal of the residual etchant is deleterious to the corrosion resistance; however, this effect in the case of the sulfuric–nitrite solution is not as pronounced as in the case of the nitric–hydrofluoric acid solution. The anticipated advantages in the new etch were not completely realized. Additional development aimed at modifying the sulfuric–nitrite etch would have to be performed in order to overcome the disadvantages before recommendation for the adoption of the etch could be made. (auth)

18128
THE CORROSION OF FUEL ELEMENTS BY WATER AND WATER VAPOR. F. Janitschek. Atomkernenergie 5, 222-9(1960) June. (In German)

Fuel element corrosion problems in water reactors were studied. Corrosion-resistant fuel elements are now available as uranium dioxide or uranium-molybdenum or -niobium alloys canned with stainless steel or alloys based on zirconium, niobium, or aluminum. (auth)

18129
STRESS CORROSION SCREENING TESTS OF MATERIALS FOR STEAM GENERATOR TUBING IN NUCLEAR POWER PLANTS. D. E. White (Westinghouse Electric Corp., Pittsburgh) and Edmund G. Johnson (Nalco Chemical Co., Chicago). Corrosion 16, 320t-4t(1960) July.

Nuclear power plant steam generator tubing materials were tested for their susceptibility to chloride stress corrosion cracking. Stressed U-bend specimens were exposed for 24 hours in a tilting autoclave to both the liquid and vapor phases of a high pH synthetic boiler water solution containing oxygen, phosphate, and 500 ppm of chloride ion. The results indicate that AISI Type 347 stainless steel, the control material, and Carpenter 7Mo are about equally susceptible to stress corrosion cracking in this test environment. Carpenter 20Cb and Type 304 having low carbon and nitrogen content displayed improved resistance. Inconel, Monel, nickel, and titanium displayed complete resistance. Ferritic steels were crack resistant but they did suffer pitting attack. (auth)

18130
CORROSION PROBLEMS OF CARBON DIOXIDE-COOLED POWER REACTORS. Vratislav Rýpar (Akimov State Research Inst. of Shielding Materials, Prague). Jaderná energie 6, 192-9(1960). (In Czech.)

Corrosion problems in nuclear reactor construction and specific characteristics of these problems are dealt with. The analysis of chemical effects of coolant gas and kinetics of the interaction between gas and reactor materials are given. Oxidation of steel and magnesium alloys is of special interest. (auth)

18131
ANODIC OXIDATION OF ZIRCONIUM. I. L. Rosenfel'd, E. N. Lantseva, and E. I. Kalinina. Zhur. Fiz. Khim. 34, 995-1003(1960) May. (In Russian)

The anodic oxidation of zirconium in salt (borate and carbonate) and acid (nitric, sulfuric, and phosphoric) solutions was investigated. The nature of the change in the terminal voltage was elucidated. The thickness of the films formed as a function of the duration of the anodizing process was determined. The current efficiency was found for the process in borate and carbonate solutions. (auth)

Fabrication

18132 ANL-5673
Argonne National Lab., Lemont, Ill.
A COATED CAST IRON CRUCIBLE FOR USE WITH EUTECTIC Al–Si ALLOY IN THE TEMPERATURE RANGE 595°–650°C. F. L. Yaggee. Nov. 1957. Decl. Feb. 4, 1960. 37p. Contract W-31-109-eng-38. OTS.

The feasibility of the coated metal crucible as a container for eutectic Al–Si alloy was proven by test. Small enamel-coated cast-iron pots have successfully withstood Al–Si alloys and an oxidizing atmosphere for a period of 3 months at 725°C. A similarly coated cast-iron crucible containing 450 pounds of eutectic Al–Si alloy was successfully tested for 144 days in a jacketing operation conducted at 595° to 650°C. Under the same conditions, the normal service life of clay-bonded graphite and silicon carbide crucibles rarely exceeds 45 days. The coating material for the iron crucible is a commercially available enamel capa-

ble of withstanding temperatures up to 790°C. It is readily applied to the surface of a variety of ferrous metals and alloys; however, best results are obtained with alloys low in chromium and nickel which also have a low thermal expansion coefficient. (auth)

18133 BRB-29
Bridgeport Brass Co., Conn.
MONTHLY PROGRESS REPORT [FOR] JANUARY 1956. Feb. 15, 1956. Decl. Mar. 30, 1960. 33p. Contract AT(30-1)-1405. OTS.

A brief summary of work on hollow slug extrusion, eccentricity and yield of extruded slugs, uranium flat plate extrusion, and process tube extrusion and reduction is presented. (J.R.D.)

18134 DMIC-Memo-54
Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.
PROBLEMS WITH RESTRAINT IN HEAVY WELDMENTS. Glenn E. Faulkner. Apr. 29, 1960. 7p. (PB-161204). OTS.

Research was initiated to evaluate thick titanium plate for use in deep-diving submarines. One of the important phases of this research is evaluation of welded joints in thick Ti alloy plates. The problems due to restraint and methods used to reduce restraint problems are reported. (W.L.H.)

18135 HW-62482
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
MAGNETIC-FORCE RESISTANCE BUTT WELDING OF ZIRCALOY-2 FUEL ELEMENT CLOSURES. L. E. Mills. Nov. 16, 1959. 12p. Contract AT(45-1)-1350. OTS.

Magnetic-force resistance welding was tested as a substitute for inert gas-shielded welding in the closure welding of swaged Zircaloy-2-clad UO_2 fuel rods for the Plutonium Recycle Test Reactor. This process depends on the electrical resistance heating of the parts to form the weld, the magnetic force holding the parts together; the weld is formed in so short a time (1/120 to 1/60 sec) that no absorption of gases in Zircaloy can occur. The effects of variables on the weld characteristics were studied; the weld zone is shown to have a very fine grain structure instead of large grain such as that produced by arc welding. Helium leak and strength tests indicate satisfactory welds. It is stated that 60 to 240 welds can be produced per hour. (D.L.C.)

18136 HW-63977(Del.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DEVELOPMENT OF A WELDING PROCESS FOR END CLOSURES ON NPR AND KER FUEL ELEMENT. T. B. Correy, I. V. Nelson, and D. E. DeWitt. Feb. 22, 1960. Decl. with deletions July 8, 1960. 5p. OTS.

With the development of the Zircaloy-2 clad U fuel element, it was necessary to develop a method of closing the end of the element after the extruded tubes were cut to the desired length. An inert atmosphere welding torch was designed and fabricated for making the welds. (W.L.H.)

18137 HW-65059
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TWIN ARGON WELDING OF ALSI-BONDED ALUMINUM CLAD URANIUM METAL FUEL ELEMENTS. Thomas B. Correy. May 6, 1960. 15p. Contract AT(45-1)-1350. OTS.

An investigation of a twin argon welding process was conducted by welding both ends of I and E fuel elements. It was found that the method produces surface finish and weld dimensions equivalent to those produced at Hanford. Since very little difference was found, further investigation was not justified. Photographs of welds produced by the twin argon process are included and the welding process is described. (J.R.D.)

18138 KAPL-1917
Knolls Atomic Power Lab., Schenectady, N. Y.
GRAIN REFINEMENT OF CAST BERYLLIUM. A. E. Bibb and S. M. Bishop. Apr. 9, 1958. Changed from OFFICIAL USE ONLY June 17, 1960. 19p. Contract W-31-109-Eng-52. OTS.

Production of a fine equiaxed as-cast grain structure in beryllium or dilute beryllium-base alloy was investigated. A review of metal-casting theory was undertaken and a systematic investigation was made of the most promising grain-refining principles. It was found that the addition of ~2.5 wt.% Al or Si produced a zone of equiaxed grains in Be ingots. Mechanical vibration was found to produce a refinement of the equiaxed zone. Additions of theoretically chosen nucleating agents further reduced the grain size of the equiaxed zone and the results indicated that with proper mixing a complete ingot could be produced which has a fine equiaxed structure. The resulting ingots could be machined and hot-rolled. Evidence of some ductility was found in both the cast and hot-rolled material. Further work is needed to exploit fully the potentiality of producing cast Be with properties comparable to those of hot-pressed powder. (auth)

18139 MND-SF-1770
Martin Co. Nuclear Div., Baltimore.
SWAGED METAL FIBER–UO_2 FUEL ELEMENT. Final Report [for] December 11, 1958 to January 15, 1960. John Kane. Jan. 1960. 105p. Contract AT(30-1)-2220. OTS.

A program is described in which a study of the variables in uranium dioxide, metal fibers, and cladding material was conducted. The effects of swaging were also examined and the thermal conductivity of various metal fiber–uranium dioxide combinations were determined. Optimum combinations of these variables were selected for application in irradiation testing. The swaged metal fiber–uranium dioxide fuel element concept was established when a swaged element containing 15 vol.% of molybdenum fibers exhibited a 30% increase in room temperature conductivity. Other aspects of fabrication are discussed, and recommendations for improved process economy are included. (J.R.D.)

18140 NAA-SR-Memo-5007
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
FABRICATION OF OMR CYLINDRICAL PROTOTYPE FUEL ELEMENT TO BE IRRADIATED IN THE OMRE. E. Garrett. Jan. 15, 1960. 22p. OTS.

A prototype cylindrical OMR fuel element was required to obtain operational and burn-up data under reactor conditions. The fabrication of a high burn-up (H.B.) No. 4 fuel element is described. The nominal enrichment was 5.7% with an actual enrichment of 5.3%. The element and hardware were of OMRE design, except for special adapters to make the transition from rectangular configuration of OMRE design to cylindrical of H. B. No. 4. The cylindrical design was completely clad by finned aluminum sheath and hot pressure bonded. The fuel alloy contained 3.5% molybdenum and 0.1 to 0.2% aluminum. (B.O.G.)

18141 NMI-2510

Nuclear Metals, Inc., Concord, Mass.

THE FABRICATION OF CLAD MASSIVE UO_2 FUEL ELEMENTS BY COEXTRUSION. Quarterly Progress Report No. 4 [for] February, March and April 1960. J. G. Hunt and P. Loewenstein. June 6, 1960. 24p. Contract AT(30-1)-1565. OTS.

A hot extrusion process, employing the multi-temperature technique, was developed which has produced UO_2 rods clad with stainless steel. The UO_2 cores are 99% theoretical density of ideal stoichiometry and have core diameters between 320 and 340 mils and lengths of 20 to 25-in. The coextruded stainless steel cladding has thicknesses between 30 and 40 mils. Although probably of sufficient quality for irradiation, the hot-coextruded, UO_2-stainless steel-clad rods have a core-cladding interface which might be improved if a better stiffness match can be achieved and maintained. A smoother core-cladding interface may be produced if the cladding is maintained stiffer or cooler or, conceivably, if the core is made hotter or softer. (auth)

18142 NMI-9608

Nuclear Metals, Inc., Concord, Mass.

DEVELOPMENT OF RANDOMLY ORIENTED WROUGHT BERYLLIUM SHEET. Third Quarterly Report to Wright Air Development Division. F. M. Yans. A. K. Wolff, and A. R. Kaufmann. May 17, 1960. 17p. Contract AF33(616)-6616.

Developments in the areas of beryllium crystal rolling, effects of turbulent flow during deformation, and initial photographic experiments in which a hot-stage microscope was used to examine polycrystalline beryllium samples are reported. (For preceding period see NMI-9605.) (J.R.D.)

18143 NYO-9006

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

THE DEVELOPMENT AND TESTING OF THE UO_2 FUEL ELEMENT SYSTEM. Progress Report for Period September 1—December 31, 1959. B. E. Murtha. 160p. Contract AT(30-1)-2379. OTS.

A substitution of one quarter hard 304 SS tubing for annealed 347 SS in the Advanced Pressurized Water Reactor (APWR) fuel rod resulted in a decrease in cladding thickness of 5 mils. A fuel cycle cost estimate for the APWR is contained. A preliminary cost analysis of fabricating UO_2 fuel elements by vibratory compaction was made. The thermally acceptable diameter for an arc-fused powder-packed fuel rod was in the range of 0.350 ± 0.005 in. for all fuel densities considered (80, 85, 90, and 94%). The use of a metal heat-transfer medium in the gas gap annulus of a pelletized fuel rod was investigated. The financial implications of (1) varying the pellet and tube tolerances of a fuel rod, (2) varying the gas gap conductivity, and (3) including the contribution of radiation in the thermal calculations were investigated. The economics of a UO_2 pellet with zoned enrichment are discussed. Preliminary experiments indicated that brazing of empty fuel tubes into cluster formations will have to be done in a vertical position. The feasibility of dip brazing as a fuel rod end-closure procedure was established. (For preceding period see NYO-2735.) (C.J.G.)

18144 ORO-274

Clevite Corp. Mechanical Research Div., Cleveland.

FUEL BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Monthly Progress Letter No. 10 [for] March 1, 1960 to March 31, 1960. R. H. Baskey. Apr. 14, 1960. 4p. Contract AT(40-1)-2557. OTS.

In development of aluminum-coated fuel-bearing fiberglas core material twelve compacts were hot pressed during the report period. Techniques which affect core edges received particular attention. Four uranium-bearing fiberglas compacts were clad rolled during March. Some improvement over previously rolled core section was evident; however, further work is required to produce plates which meet specifications. Tensile specimens taken transverse to the rolling direction were tested at room temperature, 250, 400, 600, and 800°F. The majority of the unclad transverse specimens displayed a greater strength at all temperatures than the specimens taken longitudinally to the rolling direction. (For preceding period see ORO-278.) (J.R.D.)

18145 ORO-276

Carborundum Co., Niagara Falls, N. Y.

SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Monthly Progress Report No. 8 [for] April 1 through April 31, 1960. K. M. Taylor, C. A. Lenie, P. E. Doherty, L. N. Hailey, and T. J. Keaty. May 10, 1960. 5p. Contract AT(40-1)-2558. OTS.

The effort on uranium silicide during the report period was equally divided between synthesis and fabrication. The goal for the synthesizing effort was to make U_3Si_2 of higher purity than that made in the past, and the goal for the fabrication effort was to make pellets of density higher than 93%. Both goals were achieved. Experiments in simultaneous synthesis and fabrication of uranium monocarbide are reported in which mixtures of uranium powder and carbon were hot pressed. Sintering experiments on uranium monocarbide produced pellets of 91 to 93% theoretical density; however, cracking and oxidation were observed. Further experiments are planned in which oxidation will be reduced to a minimum. (J.R.D.)

18146 TID-5951

Oregon Metallurgical Corp., Albany.

SPECIALIZED CASTING AND FORMING OF REACTIVE METAL SHAPES. Period covered: May 15, 1959—October 15, 1959. Thomas A. Hamm. 27p. For General Electric Co. Hanford Atomic Products Operation. Contract W-31-109-eng-52, Subcontract DDR-61-2. (GEH-24918). OTS.

Two experimental pours of reactor grade Zircaloy-2 were made in casting the cluster support fittings in the vertical axis centrifugal vacuum furnace. The results indicate that casting a complex configuration to shape with a minimum degree of machining is feasible. A force of 20 Gs on the mold cavity was found to be requisite for complete filling. Better solidification characteristics were obtained when gating the mold to provide a high metal head pressure to the reverse riser system. (C.J.G.)

18147 TID-6090

Stevens Inst. of Tech., Hoboken, N. J. Powder Metallurgy Lab.

SLIP CASTING OF NUCLEAR FUEL ELEMENTS. Report No. IV. Edward H. Baron, Frances H. Clark, Gregory J. Comstock, and Jack A. Yoblin. June 15, 1960. 9p. Contract AT(30-1)-2258. OTS.

APPR-type fuel plate sections were spray clad with spherical and flaked type 316 stainless steel, alone and in combination. An aqueous solution of an acrylic resin, and an alcohol water vehicle thickened with an alginate derivative were tested for suitability as spraying slips. Seventeen plates made in these tests were autoclaved for thirteen days at 330°C with only superficial attack and no blistering or separation of cladding. Liquid phase sintering tests were continued to determine the conditions by which high

densities might be obtained at reduced sintering temperatures with a minimum amount of two phase structure. Sample mass, particle size, Nicrobraz type and amount, and sintering time and temperature were varied. Development work was started on methods for applying the "picture frame" to slip cast fuel plates. (auth)

18148 WADC-TR-59-695(Pt. I)
Avco Corp. Research and Advanced Development Div., Wilmington, Mass.
BERYLLIUM JOINING RAD SPONSORED PROGRAM. [Period] covered: July 1958 to October 1959. J. B. Cohen. Jan. 12, 1960. 45p. Project title: METALLIC METALS. Task title: BERYLLIUM AND BERYLLIUM ALLOYS. Contract AF33(616)-5913. OTS.

New brazing techniques are described for joining Be to itself. A Be^{20} at.% Ag brazing alloy is shown to yield joint strengths at room temperature of 60% (30,000 psi) of that of the base metal. At 700 to 1450°F, the joint strength is 80% that of the base metal. Twenty-four hour exposures at these temperatures did not affect the room temperature strength. Similar strengths are achieved by brazing with pure Ag, if a continuous interface of Ag in the joint is absent. This is readily accomplished by heat treatment because of the rapid intergranular penetration of Ag into Be. The resulting thick joint is not deleterious, since it is shown that a two phase Ag-Be alloy with a Ag network is ductile. As in the above case, long time exposure (24 hrs) at temperatures above 1300°F did not affect the room temperature joint strength. Spreading of liquid Ag on Be is not appreciable, probably because of its rapid intergranular penetration. (auth)

18149 WADC-TR-59-695(Pt. II)
Avco Corp. Research and Advanced Development Div., Wilmington, Mass.
BERYLLIUM JOINING WADC SPONSORED PROGRAM. [Period] covered: June 1958 to October 1959. E. M. Passmore. Jan. 1960. 126p. Project title: METALLIC MATERIALS. Task title: BERYLLIUM AND BERYLLIUM ALLOYS. Contract AF33(616)-5913. OTS.

Joining of Be plates and rods by braze welding, fusion welding, and pressure welding was investigated, with the objective of developing improved methods for applications at both room and elevated temperatures. It is concluded that braze welding with silver filler metal and pressure welding without filler offer the most promise as useful joining techniques for Be. (auth)

18150 WAPD-223
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
HALOGEN ADDITIONS TO INERT-ATMOSPHERE WELD CHAMBERS. R. L. Matchett and W. L. Frankhouser. May 1960. 21p. Contract AT-11-1-GEN-14. OTS.

Halogen gas addition to an argon atmosphere in a chamber used for tungsten-arc welding of Zircaloy-2 and -3 clad nuclear fuel assemblies was investigated. Freon-12 at a concentration of 0.5 vol.% was selected from a group of five halogen gases as the standard addition. The typical weld depth-to-width ratio for vacuum-melted Zircaloy-2 welded in argon was changed from 1-to-4 to 1-to-2 by the addition of Freon-12. However, the tungsten electrode was attacked and the point shape converted to a spherical configuration. This caused the arc to become directionally unstable, resulting in wide variations in weld penetration. The chamber atmosphere was clouded with a smoke-like reaction product, which was filtered from the atmosphere in a recycle loop attached to the weld chamber. Heat inputs, at equal welding speeds, to achieve 100% penetration through a section of vacuum-melted Zircaloy-2, 0.100-in. thick were reduced by 50% when the Freon-12 addition was made. (M.C.G.)

18151
THE NEW "IMPERMEABLE" GRAPHITE. J. M. Conway-Jones (Hawker Siddeley Nuclear Power Co. Ltd., [Manchester, Eng.]). Brit. Power Eng. 1, 64-6(1960) June.

A method for rendering graphite impermeable by impregnating it with furfuryl alcohol was developed and operated on a plant scale. After impregnation under pressure on each side, the graphite is heated to 1000°C to polymerize and carbonize the trapped furfuryl alcohol. In fine-grained graphite, gas permeabilities as low as 10^{-6} cm^3/sec under a pressure differential of 1 atmosphere were obtained, and a vacuum of less than 10 μ could be held by graphite tubes for several hours at 1800°C in a N_2 atmosphere. Electrical and mechanical properties of impregnated and nonimpregnated graphite are given for comparison. This method was developed specifically for making fuel element sheaths out of graphite for use in high-temperature gas cooled reactors. (D.L.C.)

18152
FUSION WELDING OF BERYLLIUM. T. J. McDonald [(Imperial Chemical Industries, Ltd., Eng.)]; N. F. Eaton (Metropolitan Vickers Ltd., Manchester, Eng.); and D. B. Wright (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Brit. Welding J. 7, 441-50(1960) July.

Apparatus is described for experimental tungsten-arc inert-gas autogenous fusion welding of beryllium. Satisfactory welding conditions were obtained for a variety of weld designs of beryllium fabricated from ingot and sintered powder material. Work was concentrated on fuel element end cap designs where weld preheat and subsequent cooling rate were found to be critical factors in eliminating cracking when using flowing argon as an inert-gas shield. Welding in a static, pure argon atmosphere was found to require less critical control of these factors. (auth)

18153
STEEL JACKET PROTECTS BERYLLIUM DURING EXTRUSION PROCESS. R. C. Harris (Beryllium Corp., Reading, Penna.). Iron Age 186, No. 1, 84-5(1960) July 7.

A new method was developed for the fabrication of Be by extrusion; it involves the jacketing of Be with steel prior to extrusion, extruding the assembly, and removal of jacket after extrusion. The jacket acts as a lubricant, preventing Be from seizing and galling tools, and prevents oxidation. Fabrication shapes possible at the present time are rounds, squares, and rectangles; strength data are given for rod diameters from 0.5 to 2.25 inches with reduction ratios of more than 8:1. (D.L.C.)

18154
CONSTRUCTION MATERIALS AND WELDING TECHNIQUES IN REACTOR CONSTRUCTION. W. Liebig. Schweissen u. Schneiden 11, No. 6, 2p.(1959) June. (In German)

In the design, choice of materials and their machining, and construction of reactors, problems are encountered which are of particular interest to the welding engineer. Some details and examples are shown. (auth)

18155
NEW ALLOYS FOR BRAZING HEAT-RESISTING ALLOYS. W. Feduska (Westinghouse Electric Corp., East Pittsburgh, Penna.). Welding J. (N.Y.) 39, 292s-300s(1960) July.

Investigations were undertaken to develop a ductile brazing alloy or alloys which might possess superior wettabil-

ity and produce ductile joints with a number of heat-resisting alloys, without reacting excessively with them. Low-melting nickel–palladium base brazing alloys, containing beryllium and/or silicon, were developed. The most promising alloy, containing 0.25% Be, 0.49% Si, 44.3% Ni, and 54.96% Pd, has a melting range of 2040 to 2120°F, is workable into thin strip stock, produces superior wetting of Ti and/or Al bearing high-temperature alloys, causes little base-metal penetration or erosion during brazing of thin-walled wrought metals, has adequate shear strength to 1500°F, and exhibits room-temperature ductility in brazed joints of various base metals. (B.O.G.)

Properties and Structure

18156 ANL-6140

Argonne National Lab., Ill.

THE VAPORIZATION, THERMODYNAMICS, AND PHASE BEHAVIOR OF URANIUM MONOSULFIDE. E. David Cater. Mar. 1960. 189p. Contract W-31-109-eng-38. OTS.

Based on a thesis submitted to Univ. of Kansas.

Uranium monosulfide of high purity was prepared by reaction of uranium metal with hydrogen sulfide and subsequent homogenization of the crude product by heating at approximately 2300°K in a tungsten crucible in high vacuum. The vaporization of these sulfides over the temperature range from 1840 to 2770°K was investigated by the effusion method. Samples of other than one-to-one stoichiometry were found to decrease in volatility with time until the congruently evaporating composition $US_{1.00}$ was attained. The vapor in equilibrium with this solid composition was found to consist chiefly of the gaseous atoms U and S with gaseous molecules US of less, though comparable, importance. At the highest temperatures of the spectrometric study the gaseous molecule US_2 was barely detectable. The corresponding heat of dissociation of the gaseous molecule is 121 kcal/mole or 5.2 electron volts per molecule, not far less than for the corresponding gaseous monoxide. Theoretical considerations were employed to obtain the forms of equations expressing the changes of entropy and free energy for the reactions as functions of temperature and the constants were evaluated from the experimental data. Other data obtained were the melting point of uranium monosulfide (2735^{+30}_{-5}°K), its lattice parameter at room temperature (5.4903 ± 0.0002 Å), and its resistivity ($100 \pm 30 \times 10^{-6}$ ohm-cm). Schematic phase diagrams were drawn for the systems uranium-sulfur and uranium-oxygen-sulfur, and lattice parameters were obtained for uranium oxysulfide. (auth)

18157 APEX-554

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

PHASE DIAGRAM STUDIES. Progress Report No. 1 [for] January 9–March 31, 1958. R. F. Domagala. May 1960. 7p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

Phase relationships in the binary systems Y-Fe, Y-Ni, and Y-Cu are being studied. Yttrium, provided by GE-ANPD, and high purity alloying metals are being employed for all alloys. Twenty-five 20-gram "button" ingots were arc melted in each system. Conventional nonconsumable electrode arc melting techniques are being employed. Compositions were chosen at appropriate intervals from 0 to 100% of the alloying addition. Portions of each ingot in the Y-Fe and Y-Ni systems were submitted for metallographic study. A cursory melting-point study was conducted for selected alloys in both binary systems. Work with the Y-Cu alloys is being delayed until it becomes clear how much effort must be expended in establishing the phase boundaries in the other two diagrams. (auth)

18158 APEX-558

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

PROPERTIES OF HYDRIDED YTTRIUM. D. S. Parker. May 1960. 23p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

A summary of the known properties of hydrided yttrium of N_H 4.8 and 5.4 is presented. The properties covered are short-time tensile properties at room temperature to 2300°F, hardness at room temperature to 2000°F, creep rupture at 1600 to 2000°F at various stress levels, thermal conductivity, thermal expansion, specific heat, electrical resistivity, and magnetic susceptibility. (auth)

18159 APEX-561

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

PROPERTIES OF HYDRIDED ZIRCONIUM. D. S. Parker and C. L. Huffine. Dec. 1959. 38p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

The properties of hydrided zirconium at hydrogen contents of 2.70, 3.40, and 4.00 N_H are presented, although data were not available for all of the properties at each N_H. Data obtained under GE-ANPD authorization and from available literature were compiled. The properties reported consist of density, tensile strength, and hardness from room temperature to 1600°F, creep and stress rupture from 800 to 1600°F, linear thermal expansion from room temperature to 1400°F, specific heat from 32 to 1400°F, and thermal conductivity and electrical resistivity from 100 to 1000°F. (auth)

18160 CF-60-6-54

Oak Ridge National Lab., Tenn.

RELATIVE EFFECTIVENESS OF DECONTAMINATION OF VARIOUS STAINLESS STEEL SURFACE FINISHES. E. E. Pierce. June 8, 1960. 12p. Contract W-7405-eng-26. OTS.

Comparison data were needed concerning stainless steel plate and sheet for use as linings in shielded cells. An investigation was made to obtain information concerning surface finish specifications, prices, and decontamination properties of ¼-in. thick plate with a No. 1 finish, 3/16-in. thick sheet with a No. 1 finish, and 11 gauge sheet with a 2B finish. The ASTM specifications relating to stainless steel sheet and plate describes the procedures used to obtain the various finishes but does not give specific tolerances for the surface finishes. The finishes may vary considerably depending upon production conditions. (auth)

18161 HW-60142

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A THEORY OF DIFFUSION OF IMPURITIES IN PURE SILVER. J. Martin Tobin. May 15, 1959. 18p. Contract W-31-109-Eng-52. OTS.

A new ionic model for the elements to the right of silver in Period V was used in the determination of the frequency factor (D_0), and the activation energy (H) for silver. The result was an improved agreement between calculated and observed values. With the same model, the difference in ion core size and effective nuclear charge in Periods IV, V, and VI was used to calculate values of H and D_0 for the three periods. The agreement of experimental and calculated values of H is within 3% except for the element gold.

This agreement is used to support the basic assumption made in the present ionic model, that the so-called multivalent elements need not be multi-ionic when dissolved in silver. The agreement is best if silver, copper, and gold are considered to be singly ionized and the other metals doubly ionized. Non-integral ionic charges will be a reasonable extension of the present model. If the decrease in activation energy per unit ionic charge is essentially correct, the ionic charge of zinc in silver would be interpreted to be somewhat less than doubly ionized (~1.7+) and germanium greater than doubly ionized (~2.8+). Furthermore, the inert gases, krypton and xenon, appear to be less than singly ionized, but not neutral, since the ion core size of these elements is much greater for the neutral atoms. (auth)

18162 IS-138

Ames Lab., Ames, Iowa

A PROPOSED MODEL FOR HIGH TEMPERATURE CREEP OF TANTALUM. Robert E. Uhrig. May 1960. 17p. Contract W-7405-eng-82. OTS.

A model for the creep of tantalum at elevated temperature is presented in which the increase in strain rate with strain is related to the reduction of the cross-sectional area accompanying strain. Comparison of experimental data with the proposed theory indicates that the dominant creep mechanism beyond the second stage of creep starts at a point of highest temperature or at a stress concentration. It spreads throughout the volume in the immediate vicinity, and eventually results in localized "necking down." (auth)

18163 KAPL-1315

Knolls Atomic Power Lab., Schenectady, N. Y.

THE DIFFUSION OF FISSION GASES IN METALLIC FUELS. M. B. Reynolds. Apr. 8, 1955. Decl. May 3, 1960. 25p. Contract W-31-109-Eng-52. OTS.

The diffusion of fission-produced rare gases from metals is discussed. Data on the diffusion of radiokrypton from metallic U are presented. Mechanisms are proposed to explain the fact that the diffusion of radiokrypton takes place only at high temperatures and is strongly influenced by thermal cycling. (auth)

18164 LA-2392

Los Alamos Scientific Lab., N. Mex.

ELECTRICAL RESISTIVITY OF PLUTONIUM METAL BETWEEN 1.73°K and 298°K. T. A. Sandenaw and C. E. Olsen. Feb. 1960. 15p. Contract W-7405-eng-36. OTS.

A brief description of apparatus and methods used in measuring the electrical resistivity of plutonium metal at 1.73°K is given. Figures showing the electrical resistivity variations from 1.73 to 55°K, from 50 to 295°K, and from 130 to 298°K are included. Interpretation of the data reported offers confirmation for the major peaks observed in low temperature heat capacity data of plutonium. (auth)

18165 NAA-SR-3880

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PROPERTIES OF CERAMIC AND CERMET FUELS FOR SODIUM GRAPHITE REACTORS. N. R. Koenig and B. A. Webb. June 30, 1960. 50p. Contract AT-11-1-GEN-8. OTS.

Nuclear materials of interest as potential reactor fuels for sodium graphite reactors are reviewed to select those which appear most feasible for high-temperature, long-burnup application. Fuel properties such as melting point, thermal neutron absorption cross section, uranium content, chemical and physical properties, and fabrication details are presented. Other factors such as expected burnup capabilities, required enrichments, and conversion ratios were compared. A program is currently in progress to evaluate promising nuclear fuels. Fuel materials under consideration include the uranium compounds: uranium dioxide, uranium monocarbide, borides, sulfides, aluminide, nitrides, silicides, and phosphides. Various cermets are under consideration. These include dispersions of uranium compounds in matrices of uranium, uranium alloys, thorium, and thorium alloys. Included among the uranium alloy matrices are binary and ternary combinations of uranium with niobium, molybdenum, and zirconium. (auth)

18166 NAA-SR-Memo-5043

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THE EFFECT OF OPEN-AIR HEATING (1050°F) ON THE PROPERTIES OF ZIRCALOY-2. R. K. Wagner. Mar. 1, 1960. 11p. OTS.

A variety of tests was performed on sections of $\frac{1}{8}$ in. thick Zircaloy-2 strip which was heated at 1000 to 1050°F for 1 hr in an open-air environment. The test results indicate that the degree of contamination experienced during this treatment was negligible and that the mechanical properties of the material were unaffected. Recommendations are listed. (auth)

18167 NASA-TR-R-38

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

THE THEORY OF DIFFUSION IN STRAINED SYSTEMS. Louis A. Girifalco and Hubert H. Grimes. 1959. 23p. GPO.

This report supersedes NACA-TN-4408.

A general theory of solid-state diffusion in strained systems is developed on a molecular-kinetic basis. The theory predicts that for simple strains the diffusion coefficient is an exponential function of the lattice parameter and that the rate of change of the diffusion coefficient with strain is linearly related to the interatomic forces. It is also shown that for plastic flow the diffusion coefficient is a linear function of strain rate. All these conclusions are confirmed by the available data. (auth)

18168 NP-8766

Michigan. Univ., Ann Arbor. Coll. of Engineering.

FIRST PROGRESS REPORT TO MATERIALS LABORATORY WRIGHT AIR DEVELOPMENT CENTER ON EFFECT OF PRIOR CREEP ON MECHANICAL PROPERTIES. Period covered: April 1, 1959 to June 30, 1959. J. V. Gluck and J. W. Freeman. July 15, 1959. 24p. Project 02902. Contract AF33(616)-6462. (UMRI-02902-1-P).

Progress in a study of creep damage to short-time mechanical properties of aircraft structural materials is reported. Activities during the period included selection of test materials and preparation of test equipment. Limited studies were made of René 41 and Udimet 500 alloys to aid in material selection. Damage to these materials was produced by a creep exposure at 1700°F. Studies were conducted on the 80 Ni–20 Cr alloy to establish the annealing conditions necessary to produce fine grain and coarse grain conditions for creep damage. (J.R.D.)

18169 NP-8767

Michigan. Univ., Ann Arbor. Coll. of Engineering.

SECOND PROGRESS REPORT TO MATERIALS LABORATORY WRIGHT AIR DEVELOPMENT CENTER ON EFFECT OF PRIOR CREEP ON MECHANICAL PROPERTIES OF AIRCRAFT STRUCTURAL MATERIALS. Period cov-

ered: July 1, 1959 to September 30, 1959. J. V. Gluck and J. W. Freeman. Oct. 15, 1959. 31p. Project 02902. Contract AF33(616)-6462. (UMRI-02902-2-P).

Specimens of René 41 alloy were solution-treated for ½ hr at 1950°F and aged 16 hrs at 1400°F. Tensile tests were run at room temperature and several elevated temperatures to establish base properties. In tests it was found that exposure without stress for 10 hrs at 1400 and 1600°F caused slight shrinkage in this alloy while similar exposure at 1800°F caused expansion. Other effects of stressed exposures are discussed. In preparation for creep damage studies on Chromel A alloy, final annealing conditions were determined to be four hours at 1550°F for production of fine grained material and one hour at 2100°F to produce coarse-grained material. Creep-rupture tests were initiated on the annealed material at temperatures between 1000 and 1800°F. Creep exposure tests of Chromel A large grain material indicated that five hrs creep at the 10-hr rupture rate in the range 1200 to 1400°F increased the room-temperature ultimate strength and yield strength and decreased ductility. (For preceding period see NP-8766.) (J.R.D.)

18170 NP-8768

Michigan. Univ., Ann Arbor. Coll. of Engineering.

THIRD PROGRESS REPORT TO MATERIALS LABORATORY WRIGHT AIR DEVELOPMENT DIVISION ON EFFECT OF PRIOR CREEP ON MECHANICAL PROPERTIES OF AIRCRAFT STRUCTURAL MATERIALS. Period covered: October 1, 1959 to December 31, 1959. J. V. Gluck and J. W. Freeman. Jan. 15, 1960. 28p. Project 02902. Contract AF33(616)-6462. (UMRI-02902-3-P).

Work accomplished on the René 41 alloy included determination of exposure, the effects at 100/hr at 1400, 1600, and 1800°F without stress, and under stresses yielding creep deformations of approximately 1% under the same conditions on room temperature tensile properties. Creep-exposure tests of the 80 Ni–20 Cr alloy were conducted for 5 or 50 hours at 1000 to 1800°F on small- and large-grain materials. Tensile tests at room temperature indicated that the large-grain material exhibited greater increase in strength and smaller decrease in ductility than the small-grain material after prior strain at either room temperature or elevated temperature. Creep exposure for longer than 50 hr at 1800°F resulted in extensive surface cracking and negligible ductility in subsequent tensile tests. (For preceding period see NP-8767.) (J.R.D.)

18171 NP-8820

Brooklyn. Polytechnic Inst.

MAGNETORESISTANCE AND DOMAIN STRUCTURE IN THIN FERROMAGNETIC FILMS. Technical Report No. 9. Richard L. Coren and Hellmut J. Juretschke. May 15, 1960. 126p. Project No. NR-017-424. Contract Nonr-839(06).

Magnetoresistance measurements were used to determine the magnetic domain structure of Ni films. (W.L.H.)

18172 ORO-278

Clevite Corp. Mechanical Research Div., Cleveland.

FUEL BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Monthly Progress Letter No. 9 [for] Period February 1, 1960 to February 29, 1960. R. H. Baskey. Mar. 11, 1960. 4p. Contract AT(40-1)-2557. OTS.

Rolled fiberglas-reinforced aluminum was tested, and its tensile strength was found to be greater in the rolling direction than in the perpendicular direction. Details of the fabrication procedures are given. (D.L.C.)

18173 TID-6061

Denver. Univ. Denver Research Inst.

THE DETERMINATION OF THE EQUILIBRIUM PHASE DIAGRAM, ZIRCONIUM–NIOBIUM. Monthly Letter Report No. 13 for May 1, 1960 to June 1, 1960. Charles E. Lundin. June 8, 1960. 4p. Contract AT(11-1)-752. OTS.

Research on the phase equilibria of the Nb–Zr alloy system is reported as a function of composition and temperature. The invariant transformation temperature level of the monotectoid reaction was found at 615°C. An investigation was begun on the transformation kinetics of niobium-base zirconium alloys for quenching from the beta-niobium region to isothermal temperature levels below the monotectoid reaction temperature or the niobium solvus boundary. The initial efforts were directed toward developing a suitable technique for fabricating test specimens. A 90 wt.% Nb alloy was chosen for preliminary investigation because this composition is near the solvus boundary. Results of preliminary testing are included. (B.O.G.)

18174 TID-6069

Carnegie Inst. of Tech., Pittsburgh.

MEASUREMENT OF ELECTRIC FIELD GRADIENTS IN DILUTE SILVER ALLOYS BY ANGULAR CORRELATION TECHNIQUES (thesis). Carl A. Giffels. May 1960. 91p. Contract AT(30-1)-1830. OTS.

Directional correlation of the gamma rays emitted in the decay of In^{111} was studied with the indium embedded in a cubic silver lattice, and the attenuation of the correlation observed for silver alloys. The alloys studied contained one-half atomic % cadmium, indium, tin, antimony, or germanium. One-quarter and one % germanium alloys were also used. Comparisons of the results were made to predictions of three different theories of the screening of the impurity atoms' excess charge by the conduction electrons. Good agreement was obtained with two of the theories, which predicted a long range screening, while the third theory, based on a Thomas-Fermi model, was unsatisfactory. Similarity of results with ½% Sn and ½% Ge showed that the effect observed was due primarily to the valence difference of the impurity and the silver, rather than the lattice distortion caused by it, since the distortion differed by a factor of 13 for these two alloys. Subsequent analysis by x-ray fluorescence showed that the supposed 1% Ge samples used actually contained only ⅝% Ge, due to inhomogeneities present in the original ingot. (auth)

18175 TID-6070

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

POLARIZATION CAPACITANCE MEASUREMENTS ON ZIRCONIUM. Technical Report No. 34. A. B. Johnson and George Richard Hill. May 1958. 72p. Project No. 1. Contract AT(11-1)-82. OTS.

The polarization capacitance of zirconium was measured, using the method of Wagner; a ballistic galvanometer was used to measure the charge which flows to the metal-solution interface when an instantaneous potential is impressed. The capacitance of etched or sanded zirconium increased immediately after treatment and then decreased on aging and became asymptotic to the capacitance measured prior to treatment. Extrapolation of the capacitance-time curves to zero time gave a value of about 30 uf/cm^2 which should correspond to the capacitance of the film-free metal surface. Correlations of the capacitance value for samples which were not etched or abraded with the data of Charlesby indicated a film thickness of about 38 A, which is in the range reported for thin films on other metals. Other measurements show that the capacitance method indicates relative changes in surface area for zirconium; true surface areas might be determined by comparison of the extrapolated value of the zirconium capacitance with the ca-

pacitance of mercury as an ideally-smooth surface, but the reliability of the method is questionable. Observations of overvoltage effects and potential-time curves for zirconium against platinum and calomel electrodes are shown. (auth)

18176 UCRL-5350

California. Univ., Livermore. Radiation Lab.
A COMPILATION OF DATA ON THE EFFECT OF HIGH-PRESSURE HYDROGEN ON THE MECHANICAL PROPERTIES OF METALS. Harold Stromberg. Sept. 1958. 16p. Contract W-7405-eng-48. OTS.

The effect of high-pressure hydrogen on the mechanical properties of metals is reviewed. In addition to embrittlement data, correlations with cathodic hydrogen introduced into the metal in solution are presented. The test methods used to determine the various data are discussed. (C.J.G.)

18177 UCRL-5988-T

California. Univ., Livermore. Lawrence Radiation Lab.
CRYSTALLOGRAPHY OF SOME OF THE TRANSITION ELEMENT BERYLLIDES. Allan Zalkin and Donald E. Sands. May 24, 1960. 6p. OTS.

The crystallography was studied for all the beryllides of Cr, Hf, Mo, Nb, Ta, Ti, V, W, and Zr stable or metastable at room temperature. (D.L.C.)

18178 UCRL-5989-T

California. Univ., Livermore. Lawrence Radiation Lab.
SOME PROPERTIES OF VANADIUM GROUP BERYLLIDES. Oscar H. Krikorian. May 25, 1960. 9p. OTS.

Vanadium group beryllides were prepared and studied by x-ray powder diffraction and crystallographic methods. Phase and sintering study results on tantalum and vanadium beryllides are included. (J.R.D.)

18179 UCRL-5991-T

California. Univ., Livermore. Lawrence Radiation Lab.
PHASE DIAGRAMS OF ZIRCONIUM—BERYLLIUM AND RELATED SYSTEMS. Ray G. Bedford. May 31, 1960. 7p. OTS.

Phase studies were carried out on the Be—Hf, Be—Ti, and Be—Zr systems, and tentative phase diagrams are presented. The systems containing Hf and Zr are similar, and the Be—Ti system is similar to the Be—Nb system, which is as expected. (D.L.C.)

18180 WADC-TN-55-649

Illinois Inst. of Tech., Chicago. Armour Research Foundation.
RESEARCH ON PHASE RELATIONSHIPS IN MAGNESIUM ALLOYS. Period covered: June 15, 1954 to June 15, 1955. Alberts Yamamoto, David W. Levinson, and William Rostoker. Nov. 1, 1955. 101p. Project title: METALLIC MATERIALS. Contract AF33(616)-2571. (AD-89697).

The constitutions of the Mg-rich areas of the systems Mg-Th, Mg-Th-Zn, and Mg-Th-Zr were studied. A partial diagram from 0 to 70 wt.% Th of the binary Mg-Th system was constructed. The features of the diagram include a eutectic reaction at 582°C and at about 45% Th with the participating phases of the Mg solid solution (4.5% Th) and compound Mg_5Th (65% Th). The compound was formed on cooling by a peritectic reaction involving a liquid phase of about 53% Th and an unidentified Th-rich phase. The solid solubility of Th in Mg decreased with decreasing temperature from 4.5% Th at the eutectic temperature to less than 1% Th at 300°C. The crystallography of the Mg_5Th phase, determined by lineal analysis, was included. The isothermal sections at 400 and 300°C were constructed for the ternary system Mg-Th-Zn. The uncertainty concerning some of the invariant reactions in the Mg-Zn binary apply to these sections. At the lower temperature, there are three two-phase fields adjoining the Mg terminal solid solution. A ternary intermediate phase, θ, or a Th-Zn binary phase entered into equilibrium with Mg. Partial results were obtained on the Mg-Th-Zr system and complete vertical section diagrams were not constructed. Although the addition of Zr was found inconsistent, it was evident that the effect of Zr on the Mg-Th alloys seems rather small. The freezing mechanism of the ternary alloys was explored. (See also WADC-TR-56-411.) (C.T.G.)

18181 NP-tr-435

MICROHARDNESS AND ELECTRIC RESISTANCE OF TANTALUM CARBIDES IN THEIR ZONES OF HOMOGENEITY. (Mikrotverdist' ta Elektrychnii Opir Karbidiv Tantalu v Zonakh Yikh Gomogennosti). G. V. Samsonov and V. B. Rukina. Translated from Dopovidi Akad. Nauk Ukr. R.S.R., No. 3, 247-9(1957). 8p. OTS.

The microhardness and electric resistance of tantalum carbides were investigated in their zones of homogeneity for compositions of TaC_x, where x is 0.4 to 1.0 with the interval x = 0.05. (C.J.G.)

18182 SCL-T-298

THE STATISTICAL INTERPRETATION OF THE FATIGUE PROPERTIES OF MATERIAL AND THE STATISTICAL ASPECT OF SAFETY. Jan Sedláček. Translated from Sborník Státního výzkum. ústavu Tepelne Tech., 103-25 (1958). 40p. JCL.

A survey is presented of the scope of application of mathematical statistics to the explanation and study of fatigue properties of material and also a brief introduction to the statistical aspect of safety. In addition to the basic methods of the statistical theory of fatigue (e.g., the methods of Weibull, Freudenthal, Gumbel, and Prot), some newer methods, as for example the method of stochastic approximation and that of unfinished lives, are presented. From the point of view of the future development of the statistical interpretation of fatigue, the latter method appears to be the most important, especially in view of the fact that it offers a solution to the problem of reducing the long duration of fatigue tests. The use of current classical methods of mathematical statistics in the solution of technical research problems is demonstrated. In the first example the application of factorial experiments in determining the effect of chromium plating on fatigue properties is given, in the second the application of the noncentral t-distribution in constructing "safe" fatigue curves. The article concludes with some statistical considerations on safety coefficients and safety classes. (auth)

18183

REFRACTORY MATERIALS. PART II. HIGH-TEMPERATURE BEHAVIOR. Robert I. Jaffee and Daniel J. Maykuth (Battelle Memorial Inst., Columbus, Ohio). Aero Space Eng. 19, 39-44(1960) July.

The high-temperature mechanical properties of 122 refractory materials melting above 1800°C are given with an eye on structural applications. Graphs are presented for creep, recrystallization, rupture and tensile strengths, elastic modulus, thermal conductivities, and expansion coefficients. The future of such materials is discussed. (D.L.C.)

18184

CERAMIC MATERIALS FOR NUCLEAR REACTOR CONTROLS AND POISON. George L. Ploetz (Knolls Atomic Power Lab., Schenectady, N. Y.). Am. Ceram. Soc. Bull. 39, 362-5(1960) July.

The ceramic and cermet materials being used and considered for application to nuclear reactor control and burnable poison components are described. The most

important of these are boron carbide and the oxides of europium, gadolinium, samarium, and dysprosium. Neutron absorbing glass compositions based on the cadmium–rare earth–borate system also are under consideration. (auth)

18185

SINTERING OF URANIUM OXIDE IN THE RANGE OF 1200–1300°C. Kasimir Langrod (Atomics International, Canoga Park, Calif.). Am. Ceram. Soc. Bull. 39, 366-9 (1960) July.

Taking advantage of the increased sinterability of uranium oxide with an O/U ratio of 2.30 to 1, pellets of over 95% theoretical density were obtained after sintering at 1300°C. The nonstoichiometric uranium oxide mixture was prepared by blending UO_2 with U_3O_8. The sintered pellets were reduced to stoichiometric composition with hydrogen at a temperature of over 1200°C. The data reported and the process described in the manufacture of the UO_2 pellets are based on pilot plant production operations. (auth)

18186

ANODIC OXIDE FILMS ON NIOBIUM: THICKNESS, DIELECTRIC CONSTANT, DISPERSION, REFLECTION MINIMA, FORMATION FIELD STRENGTH, AND SURFACE AREA. L. Young (Univ. of British Columbia, Vancouver). Can. J. Chem. 38, 1141-7(1960) July.

The wavelengths of minimum specular reflectivity (at 11° incidence) due to interference were determined using a spectrophotometer for a series of films formed on chemically polished niobium. With a value of the refractive index n = 2.46 ± 1% at 4358 A, the spectrophotometric data give the refractive index as a function of the wavelength λ, $n = 2.26 + 0.398/(\lambda/10^3\ A - 2.56)^{1.2}$. To analyze the spectrophotometric results, an auxiliary measure of thickness was required (though, with the chart given below, the thickness of a film may be determined directly from spectrophotometric measurements alone). A combination of measurements of the a-c capacity and of the charge required to form the films gives a suitable measure of thickness (in terms of ρ/ϵ, where ϵ = dielectric constant and ρ = density) which is not dependent on a knowledge of the true surface area. The effective surface area of the chemically polished metal was then found to be about 7% greater than the apparent area. At the ionic current density used to form the films (10 ma cm^{-2}), the field strength in the oxide was estimated as 4.96×10^6 v cm^{-1}. Because the field to produce a given ionic current is lower than with Ta_2O_5 films, the capacity of films formed to a given voltage at a given current density and temperature is not so much greater for niobium than for tantalum as the dielectric constants might lead one to expect. It is suggested that there may be a correlation between dielectric constant and ionic conductivity. The Nb_2O_5 films recrystallize like Ta_2O_5 films under an applied field but more readily, at least with the purity of metal now available. (auth)

18187

A THERMODYNAMIC ANALYSIS OF THE HIGH-TEMPERATURE VAPORIZATION PROPERTIES OF SILICA. Harold L. Schick (Avco Corp., Wilmington, Mass.). Chem. Revs. 60, 331-62(1960) Aug.

A review and analysis were made of the thermochemistry of the vaporization of silica at high temperatures. Various possible reactions that can occur when silica vaporizes were considered. The free-energy change for each reaction was obtained as a function of temperature. The reaction $SiO_2(l) \rightarrow SiO(g) + 1/2\ O_2(g)$ was considered in its entirety with results consistent with earlier findings. The equilibrium constant of the reaction and the equilibrium vapor pressure of liquid silica were calculated from the heat of reaction and entropy change of the reaction. Heats of formation for $SiO_2(l)$ and $SiO(g)$ were calculated. The thermochemistry of the condensation and dissociation reactions of $SiO(g)$ was thoroughly studied. Because it could lead to a higher effective pressure in an equilibrium mixture of silica. the dissociation of oxygen was studied in the temperature range from 2900 to 3100°K. In a reducing atmosphere, decomposition of silica to produce $SiO(g)$ occurs at a much lower temperature. Therefore, reactions with three typical reducing agents, carbon, silicon, and hydrogen, were studied. Calculated vaporization data for $SiO_2(l)$ were compared with published values. (M.C.G.)

18188

ELECTRON MICROSCOPIC OBSERVATIONS OF THE STRUCTURAL MODIFICATIONS PRODUCED DURING THE ANNEAL OF SLIGHTLY WORK-HARDENED ALUMINUM. Christian Messager and Omourtague Dimitrov (Centre National de la Recherche Scientifique, Paris). Compt. rend. 250, 3479-80(1960) May 23. (In French)

The technique of electron microscopic observations was applied to slightly work-hardened aluminum in order to define the nature of the phenomena occurring for degrees of work-hardening very close to the critical work-hardening. It was shown that recrystallization after cold-working of several per cent is connected to the fragmentation of the grains in blocks of a micron during the working. For cold-working of one per cent, there is no formation of blocks. The recrystallization does not occur whatever the temperature of thermal treatment. In these conditions the dislocations cannot be eliminated completely by annealing. At higher temperature they combine to form the polygonized state. The formation of boundaries which demarcate this sub-structure was observed. (J.S.R.)

18189

EFFECT OF THE TEMPERING TEMPERATURE AND THE PURITY OF THE TRANSITORY SOFTENING OF ALUMINUM. Pierre Gobin and Jean Montuelle (Centre National de la Recherche Scientifique, Paris and École Centrale Lyonnaise, Lyon). Compt. rend. 250, 3481-3(1960) May 23. (In French)

The existence of an anomaly of the hardness during the aging of pure tempered aluminum has been previously reported (Compt. rend. 249, 2772(1959)). Some time after the tempering a sharp and brief drop in the hardness is observed. This was called transitory softening. The appearance of this anomaly was attributed to the condensation of holes into dislocations which are thus released. (tr-auth)

18190

CERAMIC COATINGS FOR HIGH TEMPERATURE SERVICE. S. W. Bradstreet, Jr. (Armour Research Foundation, Chicago). Corrosion 16, 309t-11t(1960) July.

Several types of coatings may be used for service in extreme thermal environments. For moderate temperatures (to about 1700°C) for short time periods, these coatings may be rather simple refractory layers. Under the more severe conditions of ramjet and rocket operation, reinforced materials, graded substrate-coating interfaces, or multilayers are required. Where thermal gradients are severe and where high shear stresses and abrasion exist, composites must be used which utilize controlled ablation. The principles which appear to dominate the attachment of a ceramic coating to a variety of substrates are reviewed, and the deficiencies and advantages of different combinations are discussed. Principles for tailoring protective

coatings for refractory metals is suggested, and a flame-sprayed ceramic coating of potential value as a combustion catalyst is used to illustrate these principles. (auth)

18191

EQUILIBRIUM DIAGRAM OF THE Ti–Al–Sn SYSTEM. I. I. Kornilov and T. T. Nartova (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 837-9(1960) Apr. 1. (In Russian)

The equilibrium of ternary Ti–Al–Sn in the region of the partial system Ti–Ti_3Sn–TiAl was investigated. An analysis revealed a double system composed of Ti–Al and Ti–Sn solid solutions. The Ti–Al has an α–Ti base which forms between β-phase Ti and γ-phase TiAl at 1240°C. The Ti–Sn has an α–Ti base which forms between β-phase Ti and δ-phase Ti_3Sn at 890°C. The phase diagram plotted for Ti–Al–Sn at 600°C showed phases of solid solutions of Al and Sn in α titanium (α phase); solid solution with TiAl base (γ phase); continuous solid solutions of Ti_3Al–Ti_3Sn compounds with α and δ phases; and TiSn solid solutions with a δ base. Microstructure examinations and x-ray-diffraction analysis showed no ternary phase. (R.V.J.)

18192

DIFFUSION OF TUNGSTEN CARBIDES INTO COBALT AND NICKEL. I. N. Chaporova and E. A. Shchetilina. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 5, 91-6(1959) Sept.-Oct. (In Russian)

The maximum tungsten carbide diffusion into cobalt and nickel was determined by the microstructure, x-ray diffraction, and microhardness of alloy components. (R.V.J.)

18193

PHASE TRANSFORMATIONS IN IRON–VANADIUM SYSTEM. M. I. Zakharova, L. A. Semenova, and P. N. Stetsenko (Moscow State Univ.). Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 5, 135-8(1959) Sept.-Oct. (In Russian)

Magnetic, microscopic, and x-ray-diffraction analyses of Fe–V alloys (with 27 and 47.7 wt.% V), annealed and tempered at various temperatures, indicate the existence of a second high-temperature magnetic phase (β phase) at ~200°C with a crystallized cubic face-centered lattice. (R.V.J.)

18194

STRUCTURE AND PROPERTIES OF NIOBIUM–TIN ALLOYS. M. I. Agafonova, V. V. Baron, and E. M. Savitskiĭ. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 5, 138-41(1959) Sept.-Oct. (In Russian)

Microstructure, thermal and x-ray-diffraction analyses, and hardness tests were used in plotting the constitution diagram of Nb–Sn. The compound Nb_3Sn was formed at 2000 ± 25°C. Liquid alloys with 60 wt.% Sn and over are laminated. The temperature of monotectic reaction is 730 ± 5°C. A considerable diffusion area was found at the niobium side. The Nb_3Sn (29.87 wt.% Sn) has a structure with a ±5.29 A. The Vickers hardness is 900 kg/mm^2. The transition to the superconducting state is at ~18.05°K. Solid solutions of niobium and tin have better hardness and oxidation resistance than pure niobium. (R.V.J.)

18195

LOW-TEMPERATURE TRANSPORT PROPERTIES OF COMMERCIAL METALS AND ALLOYS. IV. REACTOR GRADE Be, Mo, AND W. Robert L. Powell, James L. Harden, and Edward F. Gibson (National Bureau of Standards, Boulder, Colo.). J. Appl. Phys. 31, 1221-4(1960) July.

The thermal conductivity, electrical resistivity, Lorenz ratio, and thermoelectric power are given in the temperature range 4 to 120°K for four reactor grade metals: beryllium with sample axis parallel to the pressing axis, beryllium with sample axis perpendicular to the pressing axis, molybdenum, and tungsten, the latter two doped with ThO_2. Within the given temperature range the molybdenum and tungsten show slight maxima in thermal conductivity, but the beryllium does not. The various components of the electronic and lattice thermal conductivities and resistivities are resolved. The residual electrical resistivities are, respectively, 0.64, 1.01, 0.57, and 0.16 × 10^{-6} ohm-cm. The Lorenz ratios for molybdenum and tungsten show both maxima and minima and are always below the Sommerfeld value. The ratios for the beryllium samples have broad maxima and generally are above the Sommerfeld value. The thermoelectric powers of the samples with respect to pure copper are negative for the higher temperatures and positive for the lower temperatures. (auth)

18196

THERMIONIC PROPERTIES OF UC. George A. Haas and John T. Jensen, Jr. (U. S. Naval Research Lab., Washington, D. C.). J. Appl. Phys. 31, 1231-3(1960) July.

Thermionic emission measurements using pulse techniques were obtained from UC-coated W filaments in the temperature range of 1200 to 2100°K. From the slope and intercept of the Richardson plot, a value of ϕ = 2.94 ev and A = 33 amp/cm^2 deg^2 was indicated. There is evidence that the energy required for electrons to escape at low fields might be several tenths ev higher than the 2.94 ev value. (auth)

18197

EQUATION OF STATE FOR NINETEEN METALLIC ELEMENTS FROM SHOCK-WAVE MEASUREMENTS TO TWO MEGABARS. R. G. McQueen and S. P. Marsh (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys. 31, 1253-69(1960) July.

Plane-wave explosive systems were used to accelerate thin metal plates to high velocities. Shock pressures resulting from the collision of these driver plates with a stationary target plate are approximately three times greater than the original shock pressure in the driver plate. The photographic flash-gap technique was used to record velocities associated with the shock waves. The new experimental data extend the Hugoniot loci into the one-to two-megabar region for 19 metallic elements: Ag, Au, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sn, Th, Tl, Tl, V, W, Zn, Bi, Fe, Sb. The Hugoniot P, V, E, data were extended to a more complete P, V, E, T equation of state by use of the Mie-Grüneisen theory. The thermodynamic variable, $\gamma = V(\partial P/\partial E)_v$, necessary for this extension, was obtained by solving the Dugdale-MacDonald relation. (auth)

18198

NEUTRON DIFFRACTION INVESTIGATION OF THE $Fe_{1-\delta}S$ SYSTEM. J. T. Sparks, W. Mead, A. J. Kirschbaum, and W. Marshall (Univ. of California, Livermore). J. Appl. Phys. 31, Suppl., 356S-7S(1960) May.

The intensity of the purely magnetic (001) reflection was investigated as a function of temperature for $Fe_{1-\delta}S$ samples with δ = 0.02, 0.066, 0.099, and 0.107. Samples from the antiferromagnetic α' phase, δ = 0.02, exhibit a spin reorientation at a temperature corresponding closely to that at which the susceptibility anomaly occurs (125°C). Preliminary measurements on a stoichiometric sample, δ = 0, suggest that for this composition, two distinct spin reorientations occur, one at 140°C corresponding to the abrupt change in susceptibility and the second at 160°C. The presence of a small (001) reflection

at room temperature in the α'-phase samples and the appearance of the x-ray-powder-diffraction photographs suggest that a mixed phase region may exist below the α' transition. Quenching from above the α' transition produces samples which show no room temperature peak, and whose x-ray patterns indicate only a single phase. An examination of the (001) reflection of samples for which $\delta = 0.066$, 0.099, and 0.107, suggests that for these compositions the spins lie in the hexagonal planes from room temperature to the Néel temperature, 320°C. No anomalies were observed for $\delta = 0.066$ at the α'' transition or in the γ region. Also no evidence of disorder occurring in the spin system below T_n was observed with either $\delta = 0.099$ or $\delta = 0.107$. (auth)

18199

PROPERTIES OF COLD DRAWN URANIUM RODS. II. SOME CHARACTERISTICS OF THERMAL CYCLING GROWTH OF AS-WORKED SPECIMENS. Kō Soeno (Hitachi Ltd., [Tokyo]). J. Atomic Energy Soc. Japan 2, 260-5(1960) May. (In Japanese)

Some characteristics of thermal cycling growth in as cold-worked specimens were investigated. The growth in recrystallized specimens is in the drawing direction regardless of working degree, whereas, in as-worked specimens it is dependent upon the working degree. In less than about 11% reduction in area, it is in a radial direction. When recrystallization proceeds during thermal cycling, elongation in the drawing direction was observed after the initial contraction. These characteristics of as-worked specimens were considered in connection with preferred orientation. It was assumed that the main preferred orientation was due to the slip rotation of {010} toward the radial direction with less than about 11% reduction, and twinned orientation of {010} to the drawing direction, occurring by {130} and {172} types, was gradually increased with the working degree so as to prevail near 11%. The change in growth from the radial to the drawing direction with increased working was explained by the above assumption. Some interesting behavior of twinning on recrystallization was also observed as an important clue to the formation of preferred orientation after annealing. (auth)

18200

SPECIFIC HEAT AND THERMAL CONDUCTIVITY OF POWDERED URANIUM OXIDE U_3O_8. Vladimír Zajíc (State Inst. of Nuclear Studies, Prague). Jaderná energie 6, 200-1(1960). (In Czech.)

The average specific heat c and the average thermal conductivity λ of the powdered oxide U_3O_8 of density 3.78 g/cm^3 and of grain size about 5 microns were measured for the temperature range 20 to 100°C. The observed values $c = 0.0679$ kcal/kg°C and $\lambda = 0.119$ kcal/m^{2}hr°C are in good agreement with physical constants of similar substances. (auth)

18201

THE MECHANISM OF FORMATION OF ZIRCONIUM SPONGE IN THE MAGNESIOTHERMAL PREPARATION OF ZIRCONIUM. F. G. Reshetnikov (Rešetnikov) and E. N. Oblomeev. Kernenergie 1, 207-9(1958) Mar. (In German)

The mechanism of formation of Zr sponge in production of Zr by the magnesiothermal process was studied by labeling with an easily soluble but difficultly volatile additive (Al, Sn). It was found that the Zr sponge was formed on the walls of the reaction crucible above the melt by reaction of $ZrCl_4$ vapor with the liquid Mg which moved up through the previously formed sponge by capillary attraction. The quantity of $ZrCl_4$ which reacts with the Mg per unit time depends not so much on the surface of the melt as on the size of the crucible. To increase the reduction of $ZrCl_4$ by Mg, it is recommended that partitions be put in the crucible to serve the same purpose as the crucible walls. (tr-auth)

18202

EMBRITTLEMENT OF SOLID METALS IN A LIQUID METAL. W. A. Morgan (Dept. of Mines and Technical Surveys, Ottawa). Metal Treatment and Drop Forging 26, 333-9(1959) Sept.

A review is given of the published work on the embrittlement of solid metals by lower melting-point liquid metals. Included in the discussion are some of the theories for intergranular failure resulting from soldering and brazing operations on stressed materials. 57 references. (B.O.G.)

18203

ELECTRON MICROSCOPIC INVESTIGATION ON SEED FORMATION IN THE RECRYSTALLIZATION OF PLASTICALLY DEFORMED ALUMINUM FOILS. G. Haase and F. Granzer (Universität, Frankfurt am Main). Naturwissenschaften 47, 223-4(1960). (In German)

The orientation relationships between a deformed lattice space and the recrystallization seeds arising in them after heating were investigated by electron microscopic methods and fine region diffraction. Electron diffraction diagrams were made of deformed Al foils. Similar diagrams were made after heating in high vacuum at 500°C. The orientation variation between the newly formed subgrains and the original deformed crystal is so small that it is not detectable in the diffraction diagram. The results are in good agreement with the Cahn theory of seed formation by polygonization. (J.S.R.)

18204

A TERNARY PHASE IN THE THREE-COMPONENT ALUMINUM–COPPER–TITANIUM SYSTEM. K. Moeller and H. H. Arndt (Universität, Hamburg). Naturwissenschaften 47, 224(1960). (In German)

X-ray investigations in the intermetallic aluminum–copper–titanium system showed that in this system at the composition $AlCu_2Ti$ a phase exists which produces the interferences of the B2 structure type (CsCl type). Since in the binary boundary systems no phase with B2-type structure was found, it is to be supposed that a pure ternary phase exists. (J.S.R.)

18205

IN-PILE LOOP STUDY OF UO_2–NaK SLURRY. R. D. Carlson (Argonne National Lab., Ill.). Nuclear Sci. and Eng. 7, 508-13(1960) June.

The effect of fission on circulating a UO_2-NaK suspension was studied up to a total uranium burnup of 0.07%. A loop of one-half inch stainless steel tubing with a test volume of 250 cc was irradiated in the Argonne CP-5 reactor. The loop contained 5 vol. % (40 wt. %), 93.14% enriched UO_2 suspended in NaK alloy and was operated for 902 hr at temperatures above 350°C. No difficulty was encountered during the operation of the loop in the reactor. Examination of the slurry after irradiation showed extensive comminution of the UO_2 particles. Analytical results after termination of the experiment revealed the distribution of some fission products. 45.5% of the krypton and xenon fission gases were found in the cover gas. 82% of the cesium was found dissolved in the NaK. Cerium and zirconium were found with the UO_2. (auth)

18206

THE OBSERVATION OF SHARP INTERNAL FRICTION PEAKS IN BERYLLIUM. E. W. Dickson (Tube Invest-

ments Research Labs., Cambridge, Eng.). Phil. Mag. (8) 5, 325-33(1960) Apr.

Measurements were made as a function of strain and temperature with specimens of commercially pure beryllium. Very sharp internal friction peaks were observed which are similar to those reported as occurring in aluminum. The previously suggested mechanism giving rise to these maxima is discussed in terms of the evidence obtained here. (auth)

18207

ON THE STRUCTURE OF AN INTERMETALLIC COMPOUND OF Zr. V. N. Bykov and V. V. Kazarnikov. Soviet Phys.-Cryst. 4, 880-1(1960) June.

In a study of growth of intermetallics in liquid bismuth, a compound of the approximate composition $ZrBi_2$ was found. The existence of this compound, 66.66 at.% Bi, was established independently. The structure was determined by x-ray studies of the needlelike crystals. The density was determined pycnometrically in benzene. The preliminary results suggest that $ZrBi_2$ is not isomorphous with the series of investigated compounds of the type $MeBi_2$. (B.O.G.)

18208

EQUILIBRIUM STATES OF Ti–H AND Zr–H SYSTEMS AT LOW PRESSURES. V. V. Sof'ina and N. G. Pavlovskaya. Z. ur. Fiz. Khim. 34, 1104-9(1960) May. (In Russian)

Equilibrium states of the systems Ti–H and Zr–H were investigated at pressures of 10^{-3} to 10^{-7} mm Hg. Isosteres, isotherms, and isobars were obtained for both systems. From these it follows that equilibrium states in the Zr–H system are 130 to 160°C higher or the pressures by 3 to 4 orders of magnitude lower than in the system Ti–H. The heats of formation of titanium and zirconium hydrides were calculated. They vary with the temperature, pressure, and hydrogen concentration in the hydrides within the following limits: 19 to 44 kcal/mole for Ti–H and 29 to 42 kcal/mole for Zr–H. Curves for the temperature dependence of the heats of reaction for various hydrogen concentrations are presented for both systems. (auth)

Radiation Effects

18209 CC-1669

Chicago. Univ. Metallurgical Lab.

HEALING OF FAST-NEUTRON-INDUCED CHANGES IN GRAPHITE. II. THE EFFECT OF HEATING DURING EXPOSURE. Interim Report on problem 323 MLC 2301. T. J. Neubert, A. Novick, R. Schenck, and E. Shapiro. July 10, 1944. Decl. May 3, 1960. 11p. (A-2407). OTS.

The effect of temperature during pile exposure on the fast-neutron-induced change in properties of graphite was studied. Temperatures up to 125°C have no effect upon the rate of increase of elastic modulus; pieces exposed at 300° on the other hand show no change at all in elastic modulus. The increase in electrical resistance is an inverse function of the temperature of exposure at all temperatures in the range 60 to 300°C. (auth)

18210 CF-56-10-59

Oak Ridge National Lab., Tenn.

METALLOGRAPHIC EXAMINATION OF IRRADIATED CERAMIC FUEL ELEMENTS AND CERMET SHIELDING MATERIALS. Report No. 1. A. E. Richt and E. J. Manthos. Oct. 12, 1956. Decl. June 10, 1960. 14p. OTS.

The results of a metallographic examination of a ThO_2–UO_2 fuel element, a Si–SiC–UO_2 fuel element, Fe–CaB_6 (stainless steel-clad) neutron shield element, and a Ni–BN (stainless steel-clad) neutron shield element after reactor irradiation are given and discussed. (T.R.H.)

18211 HW-36291

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RADIOMETALLURGICAL HARDNESS AND WEIGHT RESULTS ON IRRADIATED ZIRCONIUM AND ZIRCALOY-2 SAMPLES AS REQUESTED BY THE PILE DEVELOPMENT UNIT. W. S. Kelly. Apr. 28, 1955. Decl. May 4, 1960. 6p. Contract [W-31-109-Eng-52]. OTS.

Prior to irradiation, the sixteen samples composing this test were divided into two similar groups as determined by type of material and pre-irradiation heat treatment. Each group was placed in an eight-inch aluminum perf. The perfs were charged in Tube 0961-H so that one perf was downstream near the outside of the charge, while the other was upstream and more centrally located in the pile. When discharged, the downstream perf samples had received approximately one-half the exposure received by samples in the upstream perf. The average tube water temperature at the downstream perf was approximately 20°C higher than that at the upstream perf. When the samples were removed from the perfs, it was noted that the samples from the downstream perf (Samples 12-19) had a more noticeable surface film than those from the centrally located perf (Samples 22-29). The samples were weighed, with fifteen of the sixteen samples showing a slight weight increase over the pre-irradiation weights. Samples from the downstream perf had a higher average weight gain than those from the upstream perf. The surface film on the samples was soft and easily scratched, making the measured weight gains relative rather than absolute. The hardness values of the irradiated material ranged from 66 R_C to 87 R_C, depending on the pre-irradiation heat treatment. The hardness values of the "cold" control samples, in general, were a few points lower than comparable irradiated samples. However, both the zirconium and Zircaloy-2 samples which were pre-irradiation stress relieved at 800°F in air were slightly softer after irradiation. These samples had the highest pre-irradiation hardness, indicating that attempting to stress relieve in air at 800°F will result in hardening rather than softening the sample. (auth)

18212 HW-36453

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

GRAIN SIZE STUDY ON IRRADIATED POWDER METAL URANIUM. J. R. Morgan. May 20, 1955. Decl. June 10, 1960. 8p. Contract [W-31-109-Eng-52]. OTS.

Metallographic and ultrasonic grain size determinations were found to be in good agreement. The particular slug selected for examination had deformed badly on one end after an exposure of 424 Mwd/T, while the other end was not deformed sufficiently to be noticeable to the unaided eye. One wafer was cut from each end of the slug. The wafer from the greatly deformed end showed a grain size in the order of 0.10 millimeter nominal diameter, while the wafer from the slightly deformed end had smaller grains of about 0.01 millimeter nominal diameter. Sufficient data for a rigorous evaluation of the effects of irradiation on normal uranium grain size were not yet obtained. The limited post-irradiation metallographic observation of U to date suggests that irradiation has little effect on the grain size up to 424 Mwd/T. Thus, within these uncertainties, the 0.10 or 0.01 mm grain size observed in the powder metal slug might be expected to compare with normal U grain size of

about 0.10 mm if quenched from the β phase, or about 0.05 mm if quenched from the β phase followed by an anneal in the α phase. An unexplained pattern of circles was observed on the wafer from the severely deformed end. (auth)

18213 NAA-SR-208
North American Aviation, Inc., Downey, Calif.
CYCLOTRON IRRADIATION OF FUSED FLUORIDES IN INCONEL AT ELEVATED TEMPERATURES. Walter V. Goeddel. Nov. 21, 1952. Decl. May 5, 1960. 69p. Contract AT-40-1-GEN-1064. OTS.

Fused fluoride ARE fuel ("Funak" composition: 27.5 mole % UF_4, 26.0% KF and 46.5% NaF) was irradiated in evacuated, sealed Inconel capsules, maintained at 810 to 1055°C, on the 60-inch cylotron at Berkeley. Peak power densities up to 5400 w/cm^3 were achieved in the fuel layers adjacent to the irradiated "windows" of the capsules. Measurements were made before and after irradiation on the chemical composition, magnetic susceptibility and x-ray-diffraction pattern of the fuel, and on the corrosion and grain structure of the Inconel. Observations were also made on blank runs, which were heated but not irradiated. A total of 32 runs was made, of which 20 were irradiated and 12 were controls. No evidence of appreciable fuel decomposition was observed in the sealed-type capsules, after runs of duration up to 18 hr. Experiments with pumped-type capsules, equipped with a train for analysis of gases evolved during irradiation, indicated that no appreciable evolution of F was caused by irradiation. Metallographic examination of windows irradiated at temperatures near 815°C revealed no corrosion or grain structure changes significantly different from unirradiated controls. However, irradiation-enhanced corrosion of an intergranular type was observed to set in at temperatures of about 850°C and above. The magnetic susceptibility of pure UF_3, which had not been previously reported, was measured in the course of the magnetic studies on the fuel, and found to be 39.4×10^{-6} cgs units. (auth)

18214 NAA-SR-229
North American Aviation, Inc., Downey, Calif.
SOLID STATE AND IRRADIATION PHYSICS QUARTERLY PROGRESS REPORT [FOR] OCTOBER–DECEMBER 1952. E. C. Crittenden, Jr. and F. E. Faris, eds. July 2, 1953. Decl. May 3, 1960. Contract AT-11-1-GEN-8. OTS.

Progress is reported on the following studies: electronic scattering in graphite, galvanomagnetic properties of graphite, thermocouple monitoring of graphite target temperature during cyclotron irradiation, cyclotron in-place measurements of graphite electric resistivity, thermoelectric power changes in cyclotron-irradiated graphite, x-ray measurements of irradiated graphite, graphite annealing, radiation effects in metals (annealing of interstitial-vacancy pairs by fission fragments, elastic constants, metastable alloys, order-disorder studies, annealing studies in damaged Cu, thermodynamics of imperfect lattices, electron microscope study of slip bands, displacement energy), radiation effects in insulators (optical effects in alkaline halides, entropies of activation of alkali halides, effects on magnetic susceptibility), cyclotron operation and development, statitron operation and development, and reactor irradiations. (L.T.W.)

18215 NP-8811
Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
EFFECT OF GAMMA RADIATION ON SINGLE CRYSTAL CADMIUM SULFIDE (thesis). Willet John Baird, Jr. Mar. 1958. 38p.

Basic properties of cadmium sulfide are investigated with emphasis on Co^{60} gamma radiation effects. It was found that gamma irradiation of n-type cadmium sulfide causes an increase in conductivity and carrier concentration by introducing more donor than acceptor states. (J.R.D.)

18216 ORNL-2522
Oak Ridge National Lab., Tenn.
IRRADIATION EFFECTS ON BORON-CONTAINING CERAMICS AND CERMETS. J. G. Morgan, P. E. Reagan, and M. T. Morgan. July 1, 1958. Decl. May 5, 1960. 20p. Contract W-7405-eng-26. OTS.

Studies of irradiation effects are presented on two ceramics, B_4C and BN, and three stainless-steel-clad cermets, BN–Ni, CaB_6–Fe, and Cu–B_4C, which contained natural boron. The B_4C retained dimensional stability at 1% average B^{10} burnup at temperatures up to 815°F. Property changes and gas evolution were measured on irradiated BN, both hot-pressed and as a powder. Stainless-clad BN–Ni and CaB_6–Fe showed damage at burnups of 38% for low-temperature irradiations. The Cu–B_4C material showed damage above 420°C at 18% average B^{10} burnup. The damage was thought to be primarily due to the thermal history of the Cu–B_4C specimens. (auth)

18217 REIC-11
Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.
SURVEY OF IRRADIATION FACILITIES. J. F. Kircher. Apr. 30, 1960. 179p. Project 2133. Contract AF33 (616)-6564.

A survey of reactor and gamma irradiation facilities available to the Air Force and its contractors is presented. Information on the reactor facilities includes fast-neutron flux, thermal-neutron flux (max), gamma intensity (max), power and type, status, moderator, coolant, shield, operating schedule, and irradiation space. Information on the gamma facilities includes source, maximum intensity, sample environment, sample size, sample-container size, temperature, policy, and where to direct inquiries regarding service. (M.C.G.)

18218
ORIENTATION SUPERSTRUCTURE CREATED BY NEUTRON IRRADIATION IN A MAGNETIC FIELD IN THE ALLOY Fe–Ni (50-50%). Jean Paulevé and Daniel Dautreppe (Centre d'Etudes Nucléaires, Grenoble, France). Compt. rend. 250, 3804-6(1960) June 8. (In French)

A sample of Fe–Ni alloy (50-50%) exposed to fast neutrons in a magnetic field of 2500 Oe has a uniaxial anisotropy whose energy was 9000 ergs/cm^3. The evolution of the superstructure by an anneal in a magnetic field was studied. (tr-auth)

18219
GAMMA IRRADIATION OF SILICON. I. LEVELS IN n-TYPE MATERIAL CONTAINING OXYGEN. E. Sonder and L. C. Templeton (Oak Ridge National Lab., Tenn.). J. Appl. Phys. 31, 1279-86(1960) July.

The resistivity and Hall coefficient of n-type silicon containing oxygen were measured as a function of temperature before and after a number of successive irradiations in a Co^{60} gamma-ray source. A net acceptor level 0.17 ev below the conduction band was observed to result from the irradiation. Its rate of introduction was 7×10^{-4} traps/cm^3 per photon/cm^2 in 50-ohm-cm material and was about twice that in more heavily doped material (~2 ohm-cm). Acceptor levels, lying deep within the forbidden gap, were also observed. Their total introduction

rate was smaller than that of the 0.17-ev level by a factor of 50. A lowering of the mobility below ~100°K was also a result of the irradiations. In heavily irradiated samples this lowering of the mobility was much greater than could be explained on the basis of point-charge scattering. (auth)

18220

MICROSCOPIC STUDY OF NEUTRON-IRRADIATED GERMANIUM. B. B. Meckel and R. A. Swalin (Univ. of Minnesota, Minneapolis) and E. G. K. Schwarz (Convair, San Diego, Calif.). J. Appl. Phys. 31, 1299(1960) July.

Two germanium samples were exposed to fast neutron fluxes of 10^{10} and 10^{13} nvt and then etched, one fully and the other for a short time. Photomicroscopic examination in the (III) direction revealed numerous small etch pits of random distribution which were arranged in triangular formations. The observed density values agree well with Brinkman's theory extended to germanium, and the etching patterns indicates the presence of highly strained and well-defined regions of structural damage. Spike formations may also be present. (D.L.C.)

18221

THE EFFECTS OF FAST NEUTRONS ON SOLID BODIES. O. Hauser (Zentralinstitut für Kernphysik, Dresden). Kernenergie 1, 709-14(1958) Sept. (In German)

A survey is given of the changes in physical properties of solids brought about by particle radiation, and of the nature of the radiation effects. The number of Frenkel defects produced in material irradiated with fast neutrons is calculated and compared with experimental results for graphite. (tr-auth)

18222

ENHANCED ADSORPTION AS A RESULT OF IRRADIATION OF METALS. E. Herczyńska (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Naturwissenschften 47, 224(1960). (In English)

An increase in the adsorption of anions and cations on the surfaces of gold and platinum was noted as the result of the irradiation of the metals with γ rays from a Co^{60} source at an intensity of about 800,000 r/hr. The adsorption of SO_4^{2-} and Cs was studied as a function of the irradiation time. A marked increase was observed for relatively short irradiations; with continued irradiation the adsorption returned to the initial value. It was suggested that the results could be explained by the formation of an oxide layer in the first few hours of irradiation. This oxide layer is then presumably destroyed as a result of radiation annealing. (J.S.R.)

18223

THE EMBRITTLEMENT OF MOLYBDENUM BY NEUTRON IRRADIATION. A. A. Johnson (Imperial Coll. of Science and Tech., London). Phil. Mag. (8) 5, 413-16(1960) Apr.

To determine if the same type of irradiation embrittlement which Hull and Mogford observed in EN_2 steel occurred in other body-centered cubic metals, their method was applied to molybdenum. Twenty molybdenum tensile specimens, each having a different grain size, were prepared. The specimens were placed in a sealed argon-filled aluminum canister and irradiated in BEPO for six months. The irradiated specimens were tested at a strain rate of 0.88×10^{-4} sec^{-1}. Nine were completely brittle. All the remaining specimens showed pronounced yield points and increased yield stresses. The changes in yield stress were greatest for large grain sizes. These results showed clearly that the mechanism of irradiation embrittlement was more complex than in EN_2 steel, and no straightforward interpretation of the results could be given. (M.C.G.)

PHYSICS

General and Miscellaneous

18224 AD-231046

Texas. Univ., Austin. Electrical Engineering Research Lab.

STUDIES OF IONIZED GASES WITH A 400 MEGACYCLE REFRACTOMETER. Report No. 5-39. B. M. Fannin, A. P. Deam, and A. W. Straiton. Jan. 15, 1960. 25p. Contract AF33(616)-6801.

Changes in refractive index of argon and dry air due to the ionization produced by a cobalt-60 source are presented. These measurements were made by the use of a 403-Mc refractometer with the gas under test in a cavity in which the pressure was varied from a few mm to 40 cm mercury. Refractive index changes of as much as 100 N-units were noted for argon and 0.3 N-unit for dry air, where N-units = $(n-1) \times 10^6$, n being the refractive index. (auth)

18225 AERE-R-3305

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A SCREENING PROBLEM WITH APPLICATION TO THE THETATRON. R. T. P. Whipple. Mar. 1960. 10p. BIS.

An investigation is made of the amount by which the y component of electric field due to two Lecher Wires parallel to the x-axis, through $z = 0$, $y = \pm b$, can be screened inside a cage consisting of wires parallel to the z-axis in the planes $y = \pm a$, and short circuited by conducting plates in the planes $z = \pm d$. It is shown that the reduction in E_y within the cage is of order $4d^2/\lambda^2$, where λ is the wavelength, while the magnetic field is little affected if $\lambda \gg d$. Application of the results to a proposed type of "thetatron," in which the primary current is of radiofrequency and flows in a loop of wire, while the cage might consist of a set of wires along the generators of a cylinder coaxial with the loop, is discussed. The unwanted radial electric field is reduced in about the same ratio. (auth)

18226 AFCRC-TN-59-450

Aeronutronic. Div. of Ford Motor Co., Newport Beach, Calif.

EMISSIVITY OF DISPERSED CARBON PARTICLES. Scientific Report No. 6. V. Robert Stull and Gilbert N. Plass. May 29, 1959. 41p. Contract AF19(604)-2166. (AD-227887). OTS.

The emissivity of dispersed spherical carbon particles is calculated from the Mie theory of scattering. A suitable dispersion equation is derived which represents the optical properties of carbon at flame temperatures. A general expression for the emitted radiation including all higher order scattering processes is obtained. The radiation emitted by carbon particles in flames is calculated for a range of particle radii from 50 to 800 A and for several different particle size distributions. The shift of the intensity maximum to shorter wavelengths from the blackbody maximum is quantitatively explained. (auth)

18227 AFOSR-TN-60-386

Maryland. Univ., College Park.

FREQUENCY SPECTRA OF LATTICES WHOSE PARTICLES INTERACT WITH LONG RANGE FORCES (thesis). Technical Report No. 174. John A. Davies. Apr. 1960. 195p. Contract AF49(638)-399.

The properties of the normal mode frequency spectra of lattices in which long-range interactions exist between the lattice particles are studied for two- and three-

dimensional crystal models. The models studied are, firstly, two-dimensional square lattices with either transverse vibrations normal to the plane of the lattice, or with longitudinal vibrations in the plane of the lattice. Secondly, a special three-dimensional simple cubic lattice is treated. The types of interactions assumed to exist between lattice particles are pair potentials varying as inverse powers of the distance between the interacting particles. It is found that long-range interactions give rise to types of singularities in the frequency spectrum and its derivatives which do not occur when only short-range interactions exist in the lattice. The general nature of these new types of singularities is studied, and several specific examples are given. In addition, a treatment of lattice models having only short-range interactions between constituent particles is given for purposes of comparison with the long-range potential models. (auth)

18228 AFOSR-TN-60-446

Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics and Maryland. Univ., College Park.

THE ZERO-POINT ENERGY OF AN ELECTRON LATTICE. Technical Report No. 177. Alexei A. Maradudin and Rosemary A. Coldwell-Horsfall. May 1960. 36p.

At very low densities an electron gas in a compensating uniform background of positive charge crystallizes into a body-centered cubic lattice for which the correlation energy per electron is $(-1.792/r_s)$ Ry. At higher densities the first correction to this result arises from the zero-point energy of the electrons, which can be expanded in terms of the even moments of the frequency spectrum. The first five non-vanishing moments are computed and the contribution to the zero-point energy is estimated from the remaining moments using their known asymptotic behavior. This procedure leads to the value $(2.638/r_s^{3/4})$ Ry. for the zero-point energy per electron. The low temperature specific heat per electron is found to be $56.21\ k\ r_s^{3/4}\cdot(\kappa T)^3$ Ry. The range of r_s values for which these results should be valid is discussed on the basis of Lindemann's melting formula. (auth)

18229 AFOSR-TN-60-451

Columbia Univ., New York. School of Engineering.

RADIO STAR SCINTILLATION AND MULTIPLE SCATTERING IN THE IONOSPHERE. Dimitri S. Bugnolo. Apr. 1, 1960. 34p. Project No. 9768-37650. Contract AF49(638)-350. (CU-12-60-AF-350-EE).

Recent experimental evidence of radio star scintillation indicates that multiple scattering effects are of importance in the ionosphere. It is therefore of interest to apply the transport equation for the expectation of the photon density function to this problem. The solution of the transport equation is used to predict the mean squared scattering angle and corresponding size of the ionospheric irregularities as measured on the earth. The particular example discussed in detail is based on a Gallet model for turbulence in the underside of the F layer under night-time conditions. However, it should be noted that the general theoretical results can be applied to any other model as well. (auth)

18230 APL-JHU-CM-958

Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.

MOLECULAR DIFFUSION STUDIES IN GASES AT HIGH TEMPERATURE. RESULTS AND INTERPRETATION OF THE He—A SYSTEM. R. E. Walker and A. A. Westenberg Aug. 1959. 20p. Contract NOrd-7386. (AD-227659).

The measurement of the diffusion coefficient of the gas pair helium—argon was carried out by the point-source technique over the temperature range 300 to 1100°K. Data obtained with helium as the trace gas are plotted. The pressure was one atmosphere. Findings are compared with previously reported data. Concentration profiles downstream of a point source of trace gas in a uniform laminar jet of carrier gas were used to measure binary diffusion coefficients at high temperatures and atmospheric pressures. Results are summarized and discussed. (C.H.)

18231 CRT-673

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

UNIFORM MAGNETIC FIELDS. G. E. Lee-Whiting. Feb. 1957. 29p. (AECL-419). AECL.

The parameters of a system of two pairs of circular current loops are calculated for the arrangements which produce the most uniform field in the central region; formulas are given for the magnitude of the non-zero eighth-order terms. A similar, but more limited, treatment is given to the case of two pairs of square coils. The optimum ratio of separation to length of side for one pair of square coils is calculated. Data are included. (auth)

18232 IDO-16600

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

COORDINATES FOR SEMI-RIGID MOLECULES. H. L. McMurry. May 9, 1960. 33p. Contract AT(10-1)-205. OTS.

The problem of calculating normal modes of vibration in organic molecules is discussed relative to selection of coordinates for minimizing algebraic computations. A method for choosing the coordinates, which are components of orthogonal basis vectors, is explained. (C.J.G.)

18233 LA-1738

Los Alamos Scientific Lab., N. Mex.

OPACITY OF AIR AT HIGH ALTITUDES AND HIGH TEMPERATURES. B. Kivel and H. Mayer. Aug. 5, 1954. Decl. June 6, 1960. 48p. Contract W-7405-eng-36. OTS.

The opacity and thermodynamic properties of air at temperatures above 10 ev and densities below normal were calculated. Corresponding to given densities and temperatures, self-consistent distributions of electrons in bound states and their eigenenergies were determined. From the above results, the thermodynamic properties of air and the frequency-dependent absorption coefficients were computed. The opacity, a weighted average of the latter, was determined. (auth)

18234 LA-2406

Los Alamos Scientific Lab., N. Mex.

THE ELECTRICAL RESISTIVITIES OF SAMARIUM AND EUROPIUM BETWEEN 1.4°K AND 300°K. Clayton E. Olsen. Feb. 12, 1960. 21p. Contract W-7405-eng-36. OTS.

Electrical resistivity measurements on samarium and europium were made at 1.4 to 300°K. The measurements on samarium confirm the existence of the two magnetic anomalies reported by Lock. The measurements on europium show the existence of only one resistivity anomaly, confirming the magnetic anomaly found by Klemm and Bommer. Interpretation is made of the electrical behavior as related to the magnetic behavior. (auth)

18235 LAMS-2403

Los Alamos Scientific Lab., N. Mex.

SOLUTION OF A PROBLEM TO OBTAIN THE OPTIMUM ENERGY FOR A ROCKET INITIALLY IN A CIRCULAR

ORBIT. George A. Baker, Jr. and John G. Wills. Feb. 1960. 20p. Contract W-7405-eng-36. OTS.

The rocket optimization formulation of Fried is used to obtain the equations and boundary conditions which will give the maximum energy to a rocket of given specific thrust initially in a circular orbit in a gravitational field. Numerical results are given for a problem of this type. The results show that optimization does not lead to significantly better results than the non-optimized case of the thrust always parallel to the velocity. (auth)

18236 NP-8704

Norair. Div. of Northrop Corp. Space Propulsion and Power Labs., Hawthorne, Calif.

MAGNETOHYDRODYNAMIC ORBIT CONTROL FOR SATELLITES. Sterge T. Demetriades. [1960]. 48p.

For presentation at the 1960 Pacific General Meeting, American Institute of Electrical Engineers, (Aero-Space Transportation Conference), San Diego, California, August 9-12, 1960.

Satellite orbit control requires propulsion systems capable either of frequent refueling and/or of very high specific impulse. The ultimate success of both schemes depends on the development of efficient electrical propulsion systems. The velocity requirements for various orbit changes are given and the merits of electrostatic (ion) and magnetohydrodynamic (plasma) electrical propulsion systems are compared. The air-breathing magnetogasdynamic (MGD) orbital ramjet, shows considerable promise as a means for control of low-altitude satellites. The MGD rocket (using air or other substances as expellant) shows considerable promise as a means for control of high-altitude satellites, especially when refueled by a propulsive fluid accumulator using a MGD ramjet in low altitude orbit to collect air. The theory of the MGD ramjet and the MGD rocket is developed and the power requirements as well as some of the design considerations are given. Some experiments on MGD thrust-production are described. The practical problem areas (e.g., the high resistance of the cold boundary layer, electrode design for high emission, magnet cooling, etc.) are outlined and some of the present equipment is described. It is concluded that MGD orbit control of satellites offers considerable promise when compared to existing techniques. (auth)

18237 NP-8771

Uppsala Univ.

APPROXIMATE ANALYTICAL WAVE FUNCTIONS FOR THE 1sns ^{1}S STATES OF He and He-LIKE IONS. Technical Note No. 31. Z. Ritter and R. Pauncz. Oct. 15, 1959. 20p. Contract AF61(514)-1200.

Calculations were made for the 1s2s, 1s3s, and 1s4s ^{1}S states of He and He-like ions, assuming wave functions of the symmetrized product form, u(1) v(2) + u(2) v(1). The results obtained are the best obtained till now using such a functional form and even better than some recent calculations which use angular correlations. The energy values obtained for He are: $2,1430_7$; $2,0603_8$; $2,0332_0$ for the 1s2s, 1s3s, 1s4s ^{1}S states. The wave functions obtained were checked by other criterion. (auth)

18238 NP-8773

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

SURFACE AREA DETERMINATION OF MAGNESIUM POWDERS BY SORPTION OF C-14-LABELED OLEIC ACID. C. M. Lapointe. Mar. 7, 1960. 14p. (R-60)

The chemisorption of C^{14}-labeled oleic acid on magnesium particles was used to determine the surface area of the grains when this area is only a few hundred square centimeters per gram. A simplified technique is suggested for routine measurement of several samples a day. (auth)

18239 NP-8860

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

USTANOVKA DLYA NEPOSREDSTVENNOGO ISSLEDOVANIYA FIZIKOKHIMICHESKIMI METODAMI SYSTEM NAKHODYA-SHCHIKHSYA V POLE γ-IZLUCHENIYA. (An Irradiation Unit for the Investigation of Samples by Physical or Physico-Chemical Methods in the Gamma Radiation Field). Report No. 150/ChR. Z. P. Zagurski and V. Nei. May 1960. 13p.

A Co^{60} irradiation unit with 300 gram equivalent of Ra for the investigation of samples by physical or physico-chemical methods is described. (tr-auth)

18240 ORNL-1670

Oak Ridge National Lab., Tenn.

ELECTRONUCLEAR RESEARCH DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING MARCH 20, 1954. F. T. Howard, ed. May 27, 1954. Decl. May 3, 1960. 26p. Contract W-7405-eng-26. OTS.

Nuclear physics research with the 86-in. cyclotron included measurement of excitation functions and angular distributions of fission fragments for proton-induced fission in Th^{232}, U^{235}, and U^{238}; for several elements, the measurement of the angular distributions of alpha particles from (p,α) reactions, the excitation functions for (p,2p) reactions, and the cross sections and excitation functions for (p,2n) and (p,pn) reactions, and the identification of eight new isotopes. Thick-target yields for the production of eight isotopes of interest for medical and industrial application were determined in proton bombardments, usually exceeding 1 ma; in several cases the high yield and low bombardment costs suggest interesting production possibilities. The 63-in. cyclotron now produces a deflected N^{3+} beam of 2 μa at ~29 Mev. The range-energy and the average charge-velocity relations of nitrogen ions in nickel were determined. The excitation functions for three nitrogen-induced reactions in carbon were measured. The design work for the revised 44-in. cyclotron is essentially completed and fabrication of new components is well under way. An exploratory study was completed and a proposal submitted for the construction of a 114-in. cyclotron for the acceleration of five nuclei, carbon through neon, to energies in excess of 100 Mev. The first two runs for the enrichment of gram quantities of plutonium isotopes were successfully completed; the first run yielded 0.5 g of 36% Pu^{240}. In thorium separation, 3.3 g of Th^{230} (ionium) was obtained. Techniques for confining the alpha-active materials being processed were proved to be satisfactory. The preliminary feasibility and design for a 10-Mw pressurized package reactor was completed. Further design details were worked out for the final report. (auth)

18241 ORNL-2823(Suppl.)

Oak Ridge National Lab., Tenn.

EFFECTIVE CADMIUM CUTOFF ENERGIES. SUPPLEMENT. R. W. Stoughton, J. Halperin, and M. P. Lietzke. May 27, 1960. 6p. Contract W-7405-eng-26. OTS.

Cutoff energies were calculated for height/diameter (H/D) values of 1, 3, 6, and 11.25 for cadmium cylinders. These are presented along with the values for H/D = 2 for comparison. Similar values for boron filters for H/D values of 1 and 2 are shown. (M.C.G.)

18242 ORO-286

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

IONIZATION AND CHARGE TRANSFER CROSS SECTIONS.

Technical Status Report No. 3 covering the Period March 1, 1960 to May 31, 1960. E. W. McDaniel, D. W. Martin, J. W. Hooper, and D. S. Harmer. 12p. Project B-176. Contract AT(40-1)-2591. OTS.

Preliminary measurements were made of the total ionization cross sections for protons on hydrogen over an energy range from 0.6 to 1.0 Mev. These measurements were accomplished by collecting with a transverse electric field the slow ions and electrons formed and measuring the currents collected by means of electrometers. Gas pressure uncertainty of about 20%, because of measurement with an uncalibrated ion gage, was reflected in the cross section values. (M.C.G.)

18243 SCDR-167-59

Sandia Corp., Albuquerque, N. Mex.

METHOD FOR FINDING APPROXIMATE EMISSIVITY OF VARIOUS SURFACES. F. K. Deaver. Oct. 1959. 10p. OTS.

An apparatus was assembled for determining the approximate emissivity of various surfaces. The method and apparatus are described, and difficulties and sources of error are noted. Results obtained on stainless steel surfaces are given. (W.D.M.)

18244 TID-6111

Columbia Univ., New York.

DIAMAGNETIC SHIELDING OF NUCLEI IN METALS. Richard Bersohn. June 8, 1960. 6p. Contract AT(30-1)-2498. OTS.

The diamagnetic contribution to nuclear resonance shift was calculated for the case of free electrons by an adaptation of methods used to calculate diamagnetic susceptibility. The perturbation theory was used to calculate the partition function for an electron gas in the presence of the dipole field of the nucleus and a uniform magnetic field. (M.C.G.)

18245 UCRL-6001

Purdue Univ. Lafayette, Ind. and California. Univ., Livermore. Lawrence Radiation Lab.

ANALYSIS OF SIX-BAR LINKAGE USING DIGITAL COMPUTER. A. C. Dunk and C. L. Hanson. May 20, 1960. 13p. Contract W-7405-eng-48. OTS.

The analysis of a six-bar linkage motion is difficult because of the large number of variables involved and the large number of calculations that have to be made for each position of the linkage. If a digital computer is used to make the calculations required for a multi-position analysis of a mechanism, it is feasible to design by analyzing a large number of similar linkages and selecting the optimum configuration. Expressions were derived for the output angle as a function of the input angle and the transmission angle as a function of the input angle for any single-degree-of-freedom six-bar linkage for which the parameters are known. An example showing the usefulness of a six-bar computer program as a mechanism design tool is discussed. (auth)

18246 UCRL-9184

California. Univ., Berkeley. Lawrence Radiation Lab.

RELATIVISTIC AND DIAMAGNETIC CORRECTIONS OF ATOMIC g VALUES. Ingvar P. K. Lindgren. May 9, 1960. 31p. Contract W-7405-eng-48. OTS.

A review of the theory of Zeeman effect is presented with specific attention to relativistic and diamagnetic effects. The single-electron problem is solved completely by reduction of the Dirac equation. This leads to the Breit-Margenau correction, which is proportional to the kinetic energy of the electron. The many-electron problem is treated approximately from the Breit-Dirac equation with a method based on Abragam and Van Vleck's investigation of atomic oxygen. The electron-electron interactions give rise to a correction to the classical Zeeman energy, which essentially depends on the electron density and can be interpreted as a diamagnetic effect. Formulas are developed for the matrix elements in the single-electron scheme, and a general expression is given for the total g-value correction in the case of equivalent electrons and Hund's-rule ground state. A new two-parameter radial wave function for the 4f electron is introduced, which can be fitted well to calculated Hartree functions. This wave function was used to calculate the corrections to the g value for thulium, and the result is in excellent agreement with the experimental value. (auth)

18247 USCEC-56-208

University of Southern California, Los Angeles. Engineering Center.

PRODUCTION OF CARBON IN THE UPPER ATMOSPHERE. K. P. Chopra. July 31, 1959. 12p. Project No. 17500-509. Contract AF18(603)-95. (AFOSR-TN-59-902; AD-228197).

A process is described by which penetrating cosmic rays may produce atomic carbon in the upper atmosphere. In the process it is proposed that high-energy cosmic ray particles bombard the atoms and molecules of the upper atmosphere and release neutrons along with other products of disintegration. Some of these neutrons escape outwards and undergo a natural free decay. Others may collide with nitrogen atoms and produce atomic carbon with the release of a proton. These carbon atoms are radioactive and decay back into atomic nitrogen with the release of a high energy electron. The fairly long lifetime (5569 years) ensures a copious supply of carbon atoms in the upper atmosphere. The other products of this process, viz. protons and electrons, may get trapped in the earth's magnetic field, and hence contribute to the formation of the inner radiation belt. (auth)

18248 USNRDL-TR-413

Naval Radiological Defense Lab., San Francisco.

THE INFLUENCE OF SOIL COMPOSITION ON THE THERMAL NEUTRON COMPONENT OF LARGE SCALE NEUTRON FIELDS. F. M. Tomnovec and R. L. Mather. Apr. 1, 1960. 39p.

Fast neutron fields which extend over distances large compared to a mean free path in air (such as cosmic-ray fields or nuclear weapon fields) develop an equilibrium low-energy neutron spectrum which is different in air from that in materials of the earth's surface. Near the earth's surface a transition region occurs. Cyclotron experiments were performed to simulate the changes in this region with a change of soil composition. The changes observed seemed to depend chiefly on the hydrogen content of the soil. The thermal neutron flux at the surface increased approximately 15% for each percent of water content by weight. (auth)

18249 WAL-TR-143/32

Watertown Arsenal Lab., Mass.

THE INTERACTION OF ELECTRONS WITH ELASTIC WAVES IN SOLIDS WITH RESPECT TO ULTRASONIC ATTENUATION. Emmanuel P. Papadakis. May 1960. 30p. DA Project 5B93-32-002. OTS.

Theoretical and experimental work by many researchers shows that the attenuation of ultrasonic elastic waves in metals at liquid helium temperatures is dependent upon the momentum transfer between the electrons and the lattice, the population of electrons in the normal and superconducting states, and the orientation of the elastic displacement with respect to an applied magnetic field. The

work is summarized and the results presented in equations and graphs. (auth)

18250 WCLT-TM-60-3
Wright Air Development Div. Materials Lab., Wright-Patterson AFB, Ohio.
SEVENTH MEETING OF THE ANP ADVISORY COMMITTEE FOR NUCLEAR MEASUREMENTS AND STANDARDS. Mar. 3, 1960. 44p. Project 7360.

The minutes of the seventh meeting of the ANP Advisory Committee for Nuclear Measurements and Standards are contained. It was concluded that fast neutron effects on engineering materials are not monitored properly by slow neutron and cadmium ratio measurements. It was recommended to use threshold detectors and report the actual quantities measured. (C.J.G.)

18251 AEC-tr-3896
INDIUM-GALLIUM RADIATION CIRCUIT OF THE NUCLEAR REACTOR IRT. Indiĭ-Gallievyi Radiatsionnyi Kontur Yadernogo Reaktora IRT). A. Kh. Breger, Yu. S. Ryabukhin, S. G. Tul'kes, and Ye. N. Volkov. Translated from a paper presented at the International Conference of High Energy Sources of Radiation, Warsaw, September 8-12, 1959. 12p. OTS.

A description is given of an irradiation facility employing gallium–indium alloy as the circulating working substance in the circuit. The radiator of the circuit, containing 3 l of the alloy, produces an activity of 50,000 gram-equivalent radium. (C.J.G.)

18252 AEC-tr-4092
ON THE DESIGN OF NOZZLES. I. M. Yur'ev. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr. No. 4, 140-1(1959). 6p. JCL or LC.

In application to the design of nozzles, an exact solution of a nonlinear equation which is the principle portion of the exact equation of three-dimensional flow of gas over Mach numbers 0 to 1.7 is obtained. (C.J.G.)

18253 AEC-tr-4109
RESONANCE FLUX MEASUREMENTS WITH ACTIVATION PROBES. Wolfgang Manner and Tasso Springer. Translated by G. Dessauer (Savannah River Lab.) from Nukleonik 1, 337-41(1959). 15p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6466.

18254 NP-tr-434
RESOLVING POWER OF PHOTOGRAPHIC EMULSION. (Le Pouvoir Resolvant de l'Emulsion Photographique). Vera Blumova and Josef Hrdlicka. Translated from Rev. opt. 36, 261-71(1957). 23p. OTS.

The relationship between the resolving power and contrast of a target image in a photographic layer is deduced according to an exact formula and other approximate formulas. These formulas are compared with each other using the results of emulsion studies. Resolving power study results and conclusions are included. (J.R.D.)

18255 NP-tr-442
THE THEORY OF THE STARK EFFECT IN A TIME-VARIABLE FIELD. D. Blokhintsev. Translated by E. Franklin (U.K.A.E.A. Atomic Energy Research Establishment) from Physik. Z. Sowjetunion 4, 501-15(1933). 17p. JCL.

The effects of harmonic electric fields on the radiation of atoms are investigated at various frequencies. Establishment of a continuous transition from the Stark effect to dispersion is reported, and the basis for further testing of the theory is discussed. (J.R.D.)

18256 NP-tr-453
THE TEMPERATURE DEPENDENCE OF THE OPTICAL CONSTANTS OF COPPER, SILVER AND GOLD DOWN TO 20°K. G. Joos and A. Klopfer. Translated by R. G. Evan (U.K.A.E.A. Atomic Energy Research Establishment) from Z. Physik 138, 251-65(1954). 21p. JCL.

The optical constants of Cu, Ag, and Au at temperatures between 20 and 428°K in the visible and UV spectrum were investigated. The results are explained by means of the electron theory of metals. (W.L.H.)

18257 SCL-T-309
PHYSICAL THEORIES CONCERNING THE STRENGTH OF SOLID BODIES (A SURVEY OF CONTEMPORARY IDEAS). (Fizicheskie Teorii Prochnosti Tverdykh Tel). B. N. Narzullaev and L. G. Kalmykova. Translated by Marcel I. Weinreich (Sandia Corp.) from Trudy Inst. Seismol., Akad. Nauk Tadzhik. S.S.R. 54, 103-14(1956). 15p. JCL or LC.

A survey on theories regarding the breakdown of a solid body is presented. Theories advancing a physical picture of breakdown are given as well as those which merely point out the breaking forces: Griffith's submicroscopic fissure theory, Margatroyed's picture of a solid body as composed of viscous inclusions in a solid, etc. Modifications of Griffith's theory are discussed, and it is shown that materials often have greater strength in vacuum than in air. It is concluded that a more general law, taking the time factor into account, is needed. (D.L.C.)

18258
THE ATMOSPHERIC AEROSOL. A SURVEY. E. Reeger (Universität, Vienna). Acta Phys. Austriaca 13, 161-84 (1960). (In German)

The classification of aerosol particles is possible according to varying viewpoints: (a) size, (b) origin and composition, (c) source, (d) significance and effect, and (e) investigation methods (measurement devices). The size classifications are: the small particles with radius under 0.1 mμ; the medium particles up to 100 mμ; the large particles up to 1 μ; and the giant particles up to 10 μ. For air electrical processes only the first two classifications are of significance, whereas for meteorology, hygiene, and haziness only the last two are important. The large particles and the giant particles are removed more slowly from the atmosphere than particles over or under this size range. Of the natural aerosols, the extraterrestrial fraction is quantitatively unimportant; of the terrestrial fraction, the maritime particles originate only from the sea water; the continential particles are partly inorganic (weathering or volcanism) and partly organic (animal or plant). In the artificial particles it appears suitable to differentiate between the radioactive (from uranium decay, reactor operation, and atomic bombs) and the usual particles (from traffic, combustion, and industrial production). The aerosols originate partly from synthesis (condensation and sublimation), partly from decomposition (weathering and sea water spray), and partly from coagulation (mixed particles). Particles from atomic or volcanic explosions can remain in the stratosphere for years. Visual observations of the air haziness with simultaneous dust sampling indicate a not too close relation between haziness and number of dust particles. Whereas the visual haziness at a given height (which is much greater in summer than in winter) falls almost to zero, the number of particles shows a rather continuous, almost exponential, decrease with height. Measurements of the scattering function have also been made both in the atmosphere with natural aerosols and in the laboratory with artificial mist and smoke. 20 references. (J.S.R.)

18259
THE STABILIZATION OF ELECTRICALLY CHARGED PARTICLES IN ALTERNATING FIELDS. Harold Straubel. Acta Phys. Austriaca 13, 265-73(1960). (In German)

In dependence on the Millikan method, it was shown that particles with large mass (10^{-6} to 10^{-5} g) and corresponding large charge (10^{-12} to 10^{-11} amp) can be stabilized in an inhomogeneous alternating field. For determined values of charge/mass (q/m) the stability at a given field intensity is real, which means that at significant variations of the field intensity or of q/m the particle stays in the condenser. Exceeding the given values leads to sudden oscillation input. Therefore, small variations of q/m and also variations of q and m can be very accurately determined. (tr-auth)

18260
METALLIC CONDUCTOR OF HIGH CURRENT DENSITY WITH COOLING AND THE "PRINCIPLE OF CONDUCTOR SUBSTITUTION" FOR THE PRODUCTION OF STRONG MAGNETIC FIELDS. Peter Klaudy. Acta Phys. Austriaca 13, 274-92(1960). (In German)

For the production of strong magnetic fields high current densities are necessary in the exciting conductors. Such current densities are limited slightly in good conductive cooled conductors by the heat transition number of the conductor in contact with its coolant, by the thermomechanical stress, and by the heat conductivity of the conductor. Higher current densities than with cooling of the conductor and therefore stronger stationary magnetic fields can be attained by suitable substitution of current-charged conductor with cold conductor material in the current path of the existing circuit. Favorable conditions exist especially at very low conductor temperatures. (tr-auth)

18261
HEAT CONDUCTION AND FOUNTAIN PRESSURE IN LIQUID He II. W. E. Keller and E. F. Hammel, Jr. (Los Alamos Scientific Lab., N. Mex.). Ann. Phys. (N.Y.) 10, 202-31(1960) June.

Heat conductivity measurements employing temperature differences, ΔT, up to 1°K were made for liquid He II through slits 2.13 and 3.36 μ wide and having stable, reproducible, and simple geometries. Heating curves were obtained for twelve reference temperatures between 1.08 and 2.15°K for both slits, each curve extending up to the λ-point. The validity of the London–Zilsel differential thermohydrodynamic equations is demonstrated for the limit of vanishing ΔT. In addition it is shown that when these linear equations are integrated with respect to temperature the range of validity can be extended to a much greater ΔT than heretofore expected. Data on the thermomechanical effect was obtained simultaneously, as well as with a separate slit 0.276 μ wide over the same temperature range. Fountain pressures, P_f, up to 600 mm Hg were observed. At low ΔT, P_f's are found consistent with those observed by previous investigators and in agreement with the integrated London relation. For larger ΔT's, P_f's are found greater than expected from the theory. An anomalous lowering of λ-point temperature with pressure, P_f, is observed. Also it is shown that the Allen–Reekie Rule (a relationship between heat current and P_f) as generally stated is not applicable. For both heat conductivity and fountain pressure, nonlinear effects are observed, the interpretation of which is reserved for a future paper. (auth)

18262
THEORETICAL INVESTIGATION ON STRONG SPHERO-SYMMETRICAL CONVERGENT COMPRESSION WAVES IN GASEOUS DEUTERIUM. H. Völcker (Universität, Kiel). Atomkernenergie 5, 209-17(1960) June. (In German)

The propagation of sphero-symmetrical convergent compression shocks in deuterium gas was investigated. The problem leads to a system of partial differential equations of a hyerbolic type with initial values. The initial values were calculated from the solution of the stationary flat problem. Approximate solutions of the series of differential equations were arrived at according to a numeral integration method developed by P. Lax with the aid of an electronic computer Z-22. The radial pressure increase in the area of the convergence center was compared to the solution offered by G. Guderley. A pre-heating of the gas in front of the shock surface to 3000°K, at the same pressure, was taken as the temperature increase. The effect of the temperature increase in the gas in front of the impact surface on the physical values of interest behind the shock surface, was also compared with corresponding effects due to pressure increase in the shock surface. By heating to a temperature of 1500°K under atmospheric pressure, one can expect, at a starting pressure of 1000 atmospheres behind the shock surface, fusion temperatures already immediately behind the shock surface for a sphere of 1 meter diameter and at a distance of 1 cm from the center of convergence. (auth)

18263
DISTRIBUTION SCHEME AT HEIGHTS OF THE ATMOSPHERE OF Rn, Tn, AND An AND THEIR DESCENT IN AN IDEAL CASE. Vasco Caini (Università, Siena, Italy). Atti soc. toscana sci. nat. Pisa. Mem. Ser. A 66, 387-405 (1959). (In Italian)

The problems of the distribution of the three isotopes of Rn at various altitudes and their descent in the one-dimensional and stationary case are resolved. It is found that the activity of the three gases in the atmosphere at ground level has the same proportion as that in the center of the earth and is not in equilibrium with their decay products. The collective activities present are proportional to the square root of their period. (tr-auth)

18264
ANALYTICAL INVARIANTS IN N-BODY SYSTEMS. P. Résibois and I. Prigogine (Université Libre, Brussels). Bull. classe sci., Acad. roy. Belg. (5) 46, 53-60 (1960). (In English)

The existence of a new class of analytical invariants and the coupling parameter for systems of particles in interaction are indicated. These invariants are transformed with singular Fourier transforms. It is for this reason that they do not follow the classical Poincaré theory. They are expressed with the aid of basic concepts of the modern scattering theory such as the propagator. The existence of this class of invariants necessitates a reconsideration of the ergodic problem. (tr-auth)

18265
DIFFUSION PHENOMENA AND ISOTOPE EFFECTS IN THE EXTRACTION OF FISSION-PRODUCT XENON AND KRYPTON FROM IRRADIATED U_3O_8. T. J. Kennett and H. G. Thode (McMaster Univ., Hamilton, Ont.). Can. J. Phys. 38, 945-54(1960) July.

An investigation of the diffusion of fission-product xenon and krypton from irradiated U_3O_8 powder as a function of temperature revealed isotopic fractionation and also a double-valued activation energy. The apparent fission yields of Xe^{131} and Xe^{132} show abnormal enrichments of up to a factor of 10. These enrichments appear to be related to the precursor half-lives of xenon. When isotopic fractionation exists, the diffusion results exhibit an extremely low energy of activation. (auth)

18266
EXPERIMENTALLY MEASURED VIBRATIONAL LEVELS

IN H_2^+. Paul Marmet and Larkin Kerwin (Université Laval, Quebec). Can. J. Phys. 38, 972-4(1960) July.

An electron selector was used to obtain experimental values for separation of some vibrational levels in N_2^+, NO^+, and H_2^+. The results on H_2^+ are discussed in particular because no spectroscopic data exist for this simplest molecular structure. Vibrational energy states of H_2 and H_2^+ were plotted. Appearance potential measurements were made of the H_2^+ ions formed from H_2 by electron bombardment. Narrowing vibrational intervals were clearly shown. (M.C.G.)

18267

PROOF OF THE EXISTENCE OF AN OPTIMUM PRESSURE AT THE INTERIOR OF HIGH FREQUENCY SOURCES WITH DIAPHRAGM GIVING POSITIVE ARGON IONS. Daniel Blanc and André Degeilh (Centre National de la Recherche Scientifique, Toulouse, France). Compt. rend. 250, 3313-15(1960) May 16. (In French)

The variation of the ion current extracted from a high-frequency source filled with argon is studied as a function of the flow of the gas. The current intensity is a maximum when the pressure in the source is 21.5 μ of mercury. This maximum value goes from 750 μ amp for an input of 0.2 cm^2/hr to 1700 μ amp for an input of 25 cm^3/hr (extraction voltage 4,000 v and acceleration voltage 15,000 v. (tr-auth)

18268

COEFFICIENT OF SPHERICAL ABERRATION OF DISSYMMETRIC MAGNETIC ELECTRONIC LENS. Josette Barthère, Jacques Dugas, and Pierre Durandeau. Compt. rend. 250, 3461-3(1960) May 23. (In French)

The calculation of the coefficients of spherical aberration was made for a series of dissymmetric magnetic electronic lenses, beginning with the precise measurement of the magnetic induction on the axis of these lenses. The results of these calculations are given. (tr-auth)

18269

EFFECT OF ELECTRIC FIELDS ON THE LUMINESCENCE OF α SCINTILLATORS. Jean Messier and Joseph Mattler. Compt. rend. 250, 3822-4(1960) June 8. (In French)

The exposure of some sulfides irradiated with α particles to an electric field amplifies the scintillation light. The analysis of the scintillations in the absence and presence of the field shows that the field augments neither the height nor the length of the pulses but reinforces the continuous background accompanying the scintillations. (tr-auth)

18270

EFFECTS OF CRYSTAL IMPERFECTIONS ON SPIN LATTICE RELAXATION. B. I. Kochelaev (Ul'yanov Lenin Kazan State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 1053-6(1960) Apr. 11. (In Russian)

Experimental studies were carried out on spin-lattice interactions in paramagnetic crystals. The study utilized non-ideal lattice oscillation theory. The operator of the spin-lattice interactions is taken as a coördinate function of spin and displacement of the atom carrying the spin in relation to surrounding particles. Only the nearest displaced particles distributed symmetrically in relation to paramagnetic center are considered. The crystal defect influence on spin-lattice relaxation is assumed to be considerable because the magnitude k in single background processes is 10^3 fold smaller than in electron spin. However, the experiments did not give conclusive data. (R.V.J.)

18271

PROPAGATION OF FORCED PLANE WAVES OF SMALL COMPRESSION AMPLITUDE IN VISCOUS GAS CONSIDERING THE SELF-RADIATION FIELD. V. A. Prokof'ev. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr. No. 2, 17-33(1960) Mar.-Apr. (In Russian)

Wave propagation in a radiation field is analyzed on the basis of linearized equations of radiation fluid hydrodynamics and radiation field theory equations, considering spectral and angular intensity distributions and finite velocity of radiation transmission (light velocity). The thermal emission and absorption, radiation mechanics, and intrinsic radiation energy are also considered. (R.V.J.)

18272

POWER FLOW AND STORED ENERGY IN THIN ELECTRON BEAMS. W. W. Rigrod (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys. 31, 1147-53(1960) July.

The kinetic and electromagnetic components of a-c power and stored energy are evaluated for space-charge waves along thin drifting beams of simple geometry. It is found that: (a) when a modulated beam is decelerated, it radiates power into the surrounding space; (b) when both fast and slow waves are excited by a common source, the real kinetic power varies periodically with distance, exchanging energy with the electromagnetic field; and (c) when a finite-area beam is current modulated with zero a-c velocity, the total power need not be zero. The energy transport velocity of a space-charge wave is shown to equal its group velocity when the time-average stored energy is properly evaluated. A small portion of the stored kinetic energy propagates together with the field energy as an electromechanical wave along the beam. The larger part of the kinetic energy, which can be positive or negative, is transported by the motion of the beam itself. (auth)

18273

MONTE CARLO CALCULATION OF MOLECULAR FLOW RATES THROUGH A CYLINDRICAL ELBOW AND PIPES OF OTHER SHAPES. D. H. Davis (Univ. of California, Livermore). J. Appl. Phys. 31, 1169-76(1960) July.

A method is devised for the calculation of molecular flow rates through pipes where the mean free path for intermolecular collisions is large compared to the dimensions of the pipes. Results of the calculation are given for a straight cylindrical pipe, a cylindrical elbow, the annulus between two concentric cylinders, a straight cylindrical pipe with restricted openings, and a straight cylindrical pipe with restricted openings and a plate to block the direct beam between the openings. (auth)

18274

CHARGED-PARTICLE ORBITS IN VARYING MAGNETIC FIELDS. E. I. Gordon (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys. 31, 1187-90(1960) July.

A solution for the paraxial orbits of charged particles in varying magnetic fields is given. The magnetic field is assumed to be azimuthally symmetric but is allowed to vary arbitrarily with time or axial distance. The instantaneous guiding center and radius vector of the orbit are given in terms of the initial guiding center and radius vector and two parameters which are determined from the solution of a first-order differential equation containing the magnetic-field variation. One exact and two approximate constants of the motion are evaluated and discussed. (auth)

18275

BEAM REFRIGERATION BY MEANS OF LARGE MAGNETIC FIELDS. Robert Adler (Zenith Radio Corp., Chicago) and Glen Wade (Stanford Univ., Calif.). J. Appl. Phys. 31, 1201-3(1960) July.

The resistive loading which an electron beam produces

in an adjacent structure can be made to exhibit a very low noise temperature. This is achieved by coupling to the fast cyclotron wave in a large magnetic field; the noise temperature at a given signal frequency is shown to be equal to the cathode temperature times the ratio of signal frequency to cyclotron frequency. An experiment is described in which this ratio is 1/9. The coupling structure interacts with the fast cyclotron wave but rejects the slow cyclotron wave. A noise temperature of 186°K is measured. It is shown that the large magnetic field required for beam cooling need not extend throughout the tube. (auth)

18276

RESISTANCE TO POTENTIAL FLOW THROUGH A CUBICAL ARRAY OF SPHERES. Robert E. Meredith and Charles W. Tobias (Univ. of California, Berkeley). J. Appl. Phys. 31, 1270-3(1960) July.

Precise conductivity measurements on models sectioned out from a cubic lattice of spheres in a continuous medium indicate that the effective conductance of such a system deviates from the values predicted by Lord Rayleigh's analytic solution of this potential distribution problem. Deviations become particularly significant when the spheres approach close packing, and when the conductance of spheres is much greater than that of the continuum. By use of a different function for potential, and by consideration of higher terms in the series expression for the potential in the continuous phase, Rayleigh's results are modified, yielding an analytical expression that represents effective conductance satisfactorily in the concentration region approaching close packing. (auth)

18277

CHANGES IN TRAPPING LEVELS OF ZINC SULFIDE PHOSPHORS RESULTING FROM POSITIVE ION BOMBARDMENT. William T. Allen and C. H. Bachman (Syracuse Univ., N. Y.). J. Electrochem. Soc. 106, 211-17(1959) Mar.

Utilizing a decay method which consisted of measuring the amount of visible light emitted by the ZnS:Ag phosphor 5.0 msec after excitation by weak ultraviolet, studies were made of the changes in trap distribution on the surface of phosphor crystals which previously were bombarded by Ar, H, and O ions. Interpretation of results was limited to first order kinetics. The results showed that bombardment by ions caused an increase in the number of traps at the lowest trapping level, 0.28 ev deep, as well as the creation of new traps at depths slightly greater and less than 0.28 ev This effect was independent of the ion used for bombardment. Ion bombardment caused new traps to appear at deeper trapping levels: 0.37 ev for Ar, 0.38 ev for H, and 0.39 ev for O. For the latter, the peak in the difference curve is quite sharp and clearly located at 345°K, locating its depth at 0.39 ev. This corresponds to the next trapping level with increasing depth reported in the literature and thus may indicate that this trapping level is caused by the presence of oxygen in ZnS phosphors. (auth)

18278

DYNAMICS OF A DISSOCIATING GAS. PART 2. QUASI-EQUILIBRIUM TRANSFER THEORY. M. J. Lighthill (Univ. of Manchester, Eng.). J. Fluid Mech. 8, 161-82 (1960) June.

Requirements in the quasi-equilibrium theory of gaseous transport are discussed for both diffusive and radiative properties. The extension of the diffusive properties to a system where nontranslational energy is present is included. In the theory of radiative transfer, emission and absorption of radiation by the gas are estimated on the assumption that its molecules have equilibrium energy distribution. The radiative transfer of a pure dissociating gas is discussed using oxygen as an illustrative example. (B.O.G.)

18279

THE SLOW MOTION OF A MAGNETIZED SPHERE IN A CONDUCTING MEDIUM. James R. Barthel and Paul S. Lykoudis (Purdue Univ., Lafayette, Ind.). J. Fluid Mech. 8, 307-14(1960) June.

The slow motion of a sphere, permanently and uniformly magnetized in one direction, in a viscous electrically conducting medium is considered. The line of the magnetic poles is assumed to be parallel to the direction of the motion of the sphere. The velocity and pressure fields are calculated by two iterations. The distortion of the magnetic field is calculated. An expression is obtained for total drag due to the viscous, pressure, and magnetic forces. (auth)

18280

RADIOSODIUM CONTAMINATION OF A STANDARD PREPARATION OF REACTOR PRODUCED RADIOPOTASSIUM: ITS NATURE, AMOUNT, AND SIGNIFICANCE IN BIOLOGIC WORK. Francis P. Muldowney, Antonina W. Marczynska, J. Jacques Haxhe, and Francis D. Moore (Harvard Medical School, Boston and Peter Bent Brigham Hospital, Boston). J. Lab. Clin. Med. 56, 127-32(1960) July.

In experiments contrasting the specific activity of potassium in blood and urine after injection of K^{42}, it was observed by chance that there was a seeming disequilibrium between the two. Careful study by chemical methods and by pulse height analysis showed that this seeming disequilibrium was an artefact caused by the presence of trace amounts of sodium in the radioactive potassium. This trace contamination is of considerable significance in biologic work because of the tendency of cells to separate sodium from potassium. In tracer experiments on cell permeability or metabolism, errors of interpretation as great as 30 per cent would arise from this trace contamination. Methods for its detection and freeing the material from the contaminant are discussed. (auth)

18281

INVERSE SOLUTION OF THE THOMAS-FERMI EQUATION. Louis Gold (Princeton Univ., N. J.). J. Phys. Soc. Japan 15, 1132-3(1960) June. (In English)

An inverse series solution is given for the Thomas-Fermi equation with expressions for the first eight coefficients. The series is rapidly convergent in the neighborhood of the atomic nucleus where the reduced potential $\phi \to 1$. (D.L.C.)

18282

THE DIRECT GENERATION OF ELECTRICITY. [PART] 2. B. C. Lindley (C. A. Parsons and Co. Ltd., Newcastle-upon-Tyne, Eng.). Nuclear Power 5, No. 51, 80-3(1960) July.

Generation of electricity by magnetohydrodynamic (MHD) means and by an electrochemical fuel cell is discussed. (1) MHD. If a stream of an electrically conducting fluid interacts with a magnetic or electric field, the kinetic energy of the stream may be converted to electric power. In order to do this, the fluid must be a gas and, at low gas temperatures, a substance with low ionization potential must be injected in order to induce ionization, e.g., an alkali metal such as Cs. Several conceptions of a MHD generator are described in which transverse and radial magnetic fields are used, and in which induction and pulsed streams are used. An estimate of the duct size of a 100-Mwe MHD generator is presented as a function of the gas electric con-

ductivity. (2) Fuel Cell. The fuel is supplied to the cathode and the oxidant to the anode, the two cathodes being connected through an electrolyte. An important disadvantage of such a cell is its low d-c voltage even with extensive series connection; the chemical reaction rates will have to be increased for economic operation. There are three fuel cell types: cells using H_2 and O_2 with aqueous electrolytes, redox cells, and high-temperature cells operating above 500°C with molten salts. Fuel gases from coal or oil gasification processes (H_2, CO, hydrocarbons) appear to be promising in conjunction with a high-temperature fuel cell. The best direct generation methods are concluded tentatively to be a gas-cooled reactor with thermionic diode fuel elements and a MHD generator coupled to a very high-temperature reactor. Fuel cells may find application as an economic means of increasing the operating load factor of nuclear installations. (D.L.C.)

18283

THE REFRACTIVE INDICES OF LIQUID AND SOLID ARGON. G. O. Jones and B. L. Smith (Univ. of London) Phil. Mag. (8) 5, 355-8(1960) Apr.

The refractive indices of liquid and solid argon were measured as a function of temperature between 74 and 95°K. The results, represented by the Lorentz-Lorenz function, were expressed as a function of density, and their significance discussed. (auth)

18284

UPPER LIMIT TO ANISOTROPY OF INERTIAL MASS FROM NUCLEAR RESONANCE. R. W. P. Drever (Glasgow Univ.). Phil. Mag. (8) 5, 409-11(1960) Apr.

If inertial mass is taken to arise from gravitational interaction with distant matter, it would be expected that the concentration of matter near the center of our own Galaxy would cause some anisotropy of inertia at the earth. Some sensitive checks on this anisotropy could be made by nuclear magnetic resonance and nuclear quadrupole resonance techniques. In a magnetic resonance experiment, anisotropy of inertia would be expected to shift the levels having magnetic quantum numbers $\pm 3/2$ in one direction and those which equal $\pm 1/2$ in the opposite direction, turning the line into a triplet. Similar experiments could be made using quadrupole resonance. Anisotropy would shift the upper and lower states in opposite directions altering the resonance frequency by an amount depending on the angle between the axis of electrical symmetry and the direction of the center of the Galaxy. From available data an upper limit of 10^{-20} was set for the anisotropy of inertia. (M.C.G.)

18285

FURTHER EXPERIMENTS CONCERNING THE SPIN-ELECTRON INTERACTIONS IN SUPERCONDUCTORS. B. T. Matthias, H. Suhl, and E. Corenzwit (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. and Chem. Solids 13, 156-9(1960) May. (In English)

The lowering of the superconducting transition temperature of lanthanum by dissolving in it the rare earths Ce, Nd, Sm, Eu, Tb, Ho, and Er is reported. The discrepancies regarding previous theoretical considerations are pointed out. (auth)

18286

MAGNETISM OF EUROPIUM GARNET. W. P. Wolf (Claredon Lab., Oxford) and J. H. Van Vleck (Harvard Univ., Cambridge, Mass.). Phys. Rev. 118, 1490-2 (1960) June 15.

The theoretical expressions for the magnetic moment of a trivalent europium ion in a molecular field arising from exchange are applied to Pauthenet's measurements on europium iron garnet. It was assumed that the exchange interaction stemmed entirely from the coupling with the iron atoms, which greatly simplifies the theory since the molecular field on the europium is then an impressed one and does not have to be determined self-consistently. The calculated variation of the magnetization with temperature is in excellent accord with experiment. The magnitude of the exchange interaction is compared with that in the other rare earth iron garnets; it is almost exactly the same as in gadolinium iron garnet. (auth)

18287

MAGNETIC SUSCEPTIBILITY OF METALLIC EUROPIUM. R. M. Bozorth (Bell Telephone Labs., Murray Hill, N. J.) and J. H. Van Vleck (Harvard Univ., Cambridge, Mass.). Phys. Rev. 118, 1493-8(1960) June 15.

The susceptibility of europium was measured from 1.3 to 300°K in fields up to 12 000 guass. This metal was found not to be ferromagnetic, but to have at low temperatures a very high paramagnetic susceptibility, about forty times higher than for the free ion or hydrated salts. Variation of susceptibility with field strength was observed below 100°K. The saturation curvature at low temperatures was very large, and practically independent of temperature. The susceptibility at high temperatures was consistent with a divalent model. The magnetic behavior at low temperatures was hard to interpret on the basis of a divalent ion and was more readily explained with a trivalent one for which the theory was developed. Metallurgical evidence, however, indicated that metallic europium was divalent even at low temperatures. On the other hand, it was generally believed that europium was trivalent in $EuIr_2$, but if one used the conventional molecular field theory the reported ferromagnetism of $EuIr_2$ could not be ascribed to Eu^{3+} with a value of the exchange field consistent with that in $GdIr_2$. (auth)

18288

INFLUENCE OF F CENTERS ON THE LATTICE THERMAL CONDUCTIVITY IN LiF. Robert O. Pohl (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 118, 1499-1508(1960) June 15.

The influence of photochemically produced F centers in LiF on the thermal conductivity was investigated, the density of the F centers being determined optically. The F centers decreased the thermal conductivity appreciably at low temperatures. Additive coloration of KCl had a similar effect. The experimental results were quite different from the results obtained in the case of the isotope effect in Ge. Callaway's theory for the lattice thermal conductivity in the presence of point defects did not explain the present observations satisfactorily, although it was superior to Klemens Two explanations were proposed: (1) The F centers were not randomly distributed (but the presence of clusters of F centers could be excluded in the experiments). (2) The long-range strain field around F center did not scatter like a point defect. In support of Callaway's theory, it was shown that his model could explain an experimental observation (first reported by Toxen) about the influence of point defects on the thermal conductivity. (auth)

18289

MAGNETIC PROPERTIES OF THULIUM METAL. D. D. Davis and R. M. Bozorth (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. 118, 1543-5(1960) June 15.

Measurements made from 1.3 to 300°K, in fields up to 12 000 gauss, show that thulium becomes antiferromagnetic on cooling to 60°K and is ferromagnetic below 22°K. In agreement with earlier work the susceptibility between 70 and 300°K obeys the Curie-Weiss law and the effective Bohr magneton number is 7.6, equal to the theoretical value for the trivalent ion core having two holes in the $4f$ shell. The highest observed ferromagnetic moment is only 0.5 Bohr magneton whereas the theoretical value is $gJ = 7$. Large hysteresis and crystal anisotropy are observed at the lowest temperatures. It is suggested that the anisotropy is so large that the magnetization cannot be deviated appreciably from the hexagonal axis even in the higher fields (70 000 gauss) used by Henry; he observed 3.4 Bohr magnetons whereas the highest expected for polycrystalline material on this assumption is 3.5. (auth)

18290

RESPONSE OF NaI(Tl) TO ENERGETIC HEAVY IONS. E. Newman and F. E. Steigert (Yale Univ., New Haven). Phys. Rev. 118, 1575-8(1960) June 15.

The light output of NaI(Tl) was measured as a function of energy for ions of He^4, B^{10}, B^{11}, C^{12}, N^{14}, O^{16}, F^{19}, and Ne^{20} from approximately 1.0 to 10.0 Mev/nucleon. The particle energy was varied with absorbing foils and the degraded beam analyzed in a magnetic spectrometer. Light output became linear with energy above approximately 6 Mev/amu. There appeared to be an odd-even incident charge effect in the saturation value of the differential efficiency of fluorescence, dL/dE. (auth)

18291

GENERALIZATION OF QUANTUM MECHANICS. T. E. Phipps, Jr. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 118, 1653-8(1960) June 15.

The possibility of generalizing quantum mechanics in such a way as to retain its predictive results, while comprehending additional solutions, was examined. It was found that this could be done through a perfected formal correspondence with Hamilton-Jacobi mechanics, by which generalizations were considered of the Heisenberg postulate of the form $p_k q_j - q_j p_k = S\delta_{jk}$, where S was a quantum analog of Hamilton's principal function. The formalism was shown to be equivalent to a simple change in Hamiltonian, with transformed momentum operators satisfying conventional commutation relations, and with an additional relationship involving formal analogs of the classical "initial constants" adjoined. A particular choice of $S = \hbar/i$) led to a theory identical with wave mechanics apart from a constant (unobservable) phase factor on the wave function. The fact that S might possess other, nonconstant values, demonstrated by a specific example, suggested the ability of the mechanical equations to describe a broader class of physical states than was hitherto investigated. (auth)

18292

APPROXIMATE BINDING ENERGIES OF INNER ELECTRONS IN ATOMS BY THE WKB METHOD. T. Tsang (Univ. of Chicago). Physica 25, 1241-3(1959) Dec. (In English)

Near the nucleus, the effective nuclear charge is approximately a parabolic function of the radius. Based on the WKB method modified by Langer using a least square parabolic fit of the Thomas-Fermi potential, the approximate binding energies of inner electrons may be expressed as a function of the atomic number, and principal and orbital quantum numbers. Comparison with results using the more precise Hartree method indicates that the accuracy of this method is comparable to that of the numerical calculations by Latter using the Thomas-Fermi potential directly. (auth)

18293

SOUND VELOCITY MEASUREMENTS IN LIQUID ARGON UNDER HIGH PRESSURE. A. Van Itterbeek, W. Grevendonk, W. Van Dael, and G. Forrez (Instituut voor Lage Temperaturen en Technische Fysica, Louvain, Belg.). Physica 25, 1255-8(1959) Dec. (In English)

Using an acoustical interferometer, the velocity of sound was measured in liquid argon at pressures to 75 kg/cm^2 and at 84° to 90.3°K. At 90.3°K the compressibility coefficient and the ratio of specific heats were calculated as a function of pressure. For the calculations, use was made of experimental data relating the variation of density to pressure. (auth)

18294

SPECIFIC HEAT OF MIXTURES OF He^4 AND He^3 BETWEEN 1°K AND 4°K. Z. Dokoupil, D. G. Kapadnis, K. Sreeramamurty, and K. W. Taconis (Kamerlingh Onnes Laboratorium, Leiden). Physica 25, 1369-75(1959) Dec. (In English)

Heat capacities of mixtures at concentrations of 1.00, 2.50, 7.13, 21.1, and 41.7% of He^3 in He^4 were measured at liquid helium temperatures above 1°K. The measurements on the 21.1 and 41.7% mixtures were performed up to the critical region of the respective mixture. Special attention was paid to the accurate determination of the transition temperature; the value of the λ points gave a negative shift of 1.48 degree per mole concentration in agreement with other results. (auth)

18295

I. CHARGE EXCHANGE, IONIZATION AND ELECTRON LOSS CROSS-SECTIONS IN THE ENERGY RANGE 5 TO 24 KEV. Th. J. M. Sluyters, E. de Haas, and J. Kistemaker (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). Physica 25, 1376-88(1959) Dec. (In English)

The charge exchange, ionization, and electron loss cross-sections for the reactions Ar^+ and Ar in H_2, He, Ne, Ar, Kr, and Xe were examined in single collision conditions. The total cross sections were determined by using the condenser method. Comparisons with experimental and theoretical results were made. Different collision processes in the excited state are possible. The ionization cross sections by ions are higher than the ionization cross sections by atoms. In some collision combinations the roughly estimated distance of interaction for the ionization process is compared with the distance of interaction for charge exchange determined by the criterion of Massey. (auth)

18296

II. EXCITATION MECHANISM OF Ar^+ IONS IN He, Ne, Ar, Kr AND Xe. Th. J. M. Sluyters and J. Kistemaker (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). Physica 25, 1389-1404(1959) Dec. (In English)

In order to obtain information about the excitation processes caused by a monoenergetic ion beam in gases a grating monochromator, built for the spectral range 1000 to 6500Å, was mounted perpendicular to a collision chamber. The spectrograph was calibrated with a standard tungsten lamp. Light emission was examined for 5 to 24 kev Ar^+ ions in low-pressure noble gases. Arc and spark spectra were measured from the bombarding particle as well as from the target gas. The spectral features were interpreted in terms of different collision mechanisms.

Absolute optical emission functions were examined for the Ar II spectral lines λλ 4610, 4658, 4765, and 4806 Å in the collision combinations Ar^+ in He, Ne, Ar, Kr, and the Xe II line λ 2475 Å for Ar^+ in Xe. In the collision combinations Ar^+ in He and Ne the emission cross section of the line λ 4658 ($^2P^0_{1/2}-{}^2P_{3/2}$) is equal to the exitation cross section of the energy level $^2P^0_{1/2}$. Influence of cascade effects on the slopes of the different emission functions was apparent. The excitation cross sections of the primary argon ions in He are larger than in Ne. In the energy range of 5 to 24 kev the measured emission cross sections are between 10^{-19} and 5×10^{-18} cm^2. (auth)

18297

INFRARED PHENOMENA IN QUANTUM ELECTRODYNAMICS. I. THE PHYSICAL ONE-ELECTRON STATES IN THE INFRARED REGION. W. Van Haeringen (Rijksuniversiteit, Utrecht). Physica 26, 289-305(1960) May. (In English)

Existing treatments of the infrared divergences in quantum electrodynamics was considered anew. The approximate model introduced in 1937 by Bloch and Nordsieck is rediscussed. It is explicitly shown to be a good substitute for the complete theory as long as one restricts oneself to infrared radiation. A non-covariant diagram technique is used to prove that neglect of recoil and pair effects is indeed allowed in the infrared radiation range. The effects of vacuum polarization and charge renormalization require special attention. They are treated in second order with the regularization method of Pauli and Villars. (auth)

18298

INFRARED PHENOMENA IN QUANTUM ELECTRODYNAMICS. II. BREMSSTRAHLUNG AND COMPTON SCATTERING. W. Van Haeringen (Rijksuniversiteit, Utrecht). Physica 26, 306-25(1960) May. (In English)

The infrared aspects of quantum electrodynamics are discussed by treating two examples of scattering processes, bremsstrahlung and Compton scattering. A non-covariant diagram technique is used which gives very clear insight in the cancelling of infrared divergences between real and virtual photons. The treatment of Compton scattering shows the necessity of reformulating a theorem of Thirring on the validity of the Thomson scattering formula at very low energies. (auth)

18299

THE $^2\Sigma_u^+ \longleftrightarrow {}^2\Sigma_g^+$ TRANSITION IN H_2^-. B. K. Gupta (Osmania Univ., Hyberabad, India). Physica 26, 335-6 (1960) May. (In English)

The oscillator strength for the $^2\Sigma_g^+ \longleftrightarrow {}^2\Sigma_u^+$ transition is of interest because the H_2^- ion may play a role in determining the continuous absorption in low-temperature stellar atmospheres. These strengths have been calculated using the dipole length formula. Energy differences for $^2\Sigma_g^+ - {}^2\Sigma_u^+$ and f-values are given for corresponding internuclear distances in H_2^-. (B.O.G.)

18300

THE MECHANOCALORIC EFFECT IN LIQUID HELIUM ABOVE 0.3°K. G. J. C. Bots and M. J. F. J. Coremans (Kamerlingh Onnes Laboratorium, Leiden). Physica 26, 342-7(1960) May. (In English)

Measurements were performed on the mechanocaloric effect in liquid helium to 0.4°K. A calorimeter partly filled with 20 g of a paramagnetic salt and 9 cm^3 of liquid helium was connected by means of a superleak to a metal bellows which was totally filled with liquid. By changing the volume of the bellows superfluid helium could be made to flow into or out of the calorimeter causing a cooling or heating, respectively. Changes in temperature were of the order of a few hundredths of a degree for a flow of about 1 cm^3. The results are compared with values derived from H. London's formula making use of the specific heat data of Kramers e.a. and Wiebes e.a. The agreement is good. At temperatures below 0.8°K an extra heat capacity was found in our calorimeter as was observed by Wiebes e.a. in their experiments on the specific heat of liquid helium. The results of measurements above 1°K are in good agreement with the theory. (auth)

18301

SOME REMARKS ON THE EXTRA HEAT CAPACITY OF A VESSEL CONTAINING LIQUID HELIUM AND A PARAMAGNETIC SALT. J. M. Reynolds, G. J. C. Bots, and M. J. F. J. Coremans (Kamerlingh Onnes Laboratorium, Leiden). Physica 26, 348-50(1960) May. (In English)

The extra absorption of heat, which occurred in the experiments on the mechanocaloric effect and had been found earlier by Wiebes, Niels-Hakkenberg, and Kramers in their investigation of the specific heat of liquid helium, is discussed. (auth)

18302

LOW EVEN CONFIGURATIONS IN THE FIRST SPECTRUM OF THORIUM (Th I). R. E. Trees (National Bureau of Standards, Washington, D. C.). Physica 26, 353-60(1960) May. (In English)

Positions of twenty-one observed levels in the $6d^2\ 7s^2$ and $6d^3\ 7s$ configurations of Th I are calculated with a mean error of ±143 cm^{-1}, by use of seven adjustable parameters. This mean error is reduced to ±47 cm^{-1} by use of the L(L + 1) correction in a calculation with eleven adjustable parameters. The agreement between observed and calculated g-values is satisfactory. The parameters are compared with ones already published for related configurations in the spectra of Th II and Th III. With one exception, similarly defined parameters show a roughly linear variation with the degree of ionization, in accordance with simple expectation. The effect of neglecting the $6d^4$ configuration in Th I is briefly discussed to explain this exception. (auth)

18303

THE IONIZATION BY POLONIUM ALPHA PARTICLES IN AIR AND THE AVERAGE ENERGY TO MAKE AN ION PAIR. William P. Jesse (St. Procopius Coll., Lisle, Ill.). Radiation Research 13, 1-17(1960) July.

A determination of W, the average energy to produce an ion pair, in dry carbon dioxide-free air was made for the α particles from Po^{210}. The ionization was measured at air pressures of 5 cm of mercury, where conditions are optimum for a minimum loss by ion recombination. The value obtained was 34.96 ± 0.07 ev/ion pair, a result somewhat lower than in earlier determinations. Comparison measurements under the same conditions yielded absolute values for N_2 and C_2H_4 of 36.39 ± 0.07 and 28.03 ± 0.05 ev/ion pair, respectively, in good agreement with older values. This agreement confirms the known fact that columnar recombination difficulties are much less severe in these two gases than in air. The present value for W in air under conditions of minimum ion recombination would seem to present difficulties for the suggestion that W for α and β particles may be the same, the apparent differences being attributed to experimental errors due to ion recombination in the α-particle determinations. In the light of recent measurements the W for β particles is probably not greater than 34.0 ev/ion pair. Such a result would seem hard to reconcile with the present value of approximately 35.0 ev/ion pair for the polonium α particle. Such considerations, however, do not rule out the possibility that with increasing α particle energy the ratio W_α/W_β ap-

proaches unity as a limit, as has already been suggested. Less precise measurements of the ionization in air from single α particles, ranging in energy from 1 to 5 Mev, are in fairly good accord with older measurements, where good ion collection in air at atmospheric pressure is achieved by the use of extremely high fields. (auth)

18304

EXPERIMENTAL INVESTIGATION OF ELECTROMAGNETIC WAVE PROPAGATION ALONG A CYLINDER OF IONIZED GAS. V. I. Zimina. Radiotekh. i Elektron. 5, 938-42(1960) June. (In Russian)

Experimental studies of decimetric electromagnetic wave propagation along cylindrical tubes filled with ionized gas confirmed basic theoretical data. The phase velocity rate, the damping of propagating waves, coefficient of deceleration, and the magnitude of critical electric penetrability were studied as functions of electron concentration. (R.V.J.)

18305

ANALYTICAL SELF-CONSISTENT FIELD FUNCTIONS FOR THE ATOMIC CONFIGURATIONS $1s^2$, $1s^22s$, AND $1s^22s^2$. C. C. J. Roothaan (Argonne National Lab., Ill.); Lester M. Sachs (Argonne National Lab., Ill. and Illinois Inst. of Tech., Chicago); and A. W. Weiss (Univ. of Chicago). Revs. Modern Phys. 32, 186-94(1960) Apr.

A generalized self-consistent field (SCF) function formalism is given for the atomic configurations $1s^2$, $1s^22s$, and $1s^22s^2$ for atoms and ions up to Z = 10. The treatment is similar to that of Nesbet except for the approximations involved in the Lagrangian multipliers coupling the inner and outer shells. Results are given for Li ions and Be, and the SCF orbitals are stated to be equivalent to solutions of the integro-differential Hartree-Fock equations to 4 decimal places. (D.L.C.)

18306

BASIS FUNCTIONS FOR AB INITIO CALCULATIONS. Leland C. Allen (Univ. of California, Berkeley) and Arnold M. Karo (Univ. of California, Livermore). Revs. Modern Phys. 32, 275-85(1960) Apr.

A compilation and basis function analysis are given for existing ab initio molecular eigenfunctions in which a direct solution of the Schrödinger equation is attempted and all integrals are rigorously evaluated; thus, calculations using Mulliken integral approximations or electrostatic models are omitted. The survey is also limited to molecular wave functions that involve more than two electrons and employ one-electron basis orbitals. (D.L.C.)

18307

FORCE CURVES FOR EXCITED ELECTRONIC STATES. William L. Clinton and Walter C. Hamilton (Brookhaven National Lab., Upton, N. Y.). Revs. Modern Phys. 32, 422-5(1960) Apr.

Calculations are presented for the intramolecular forces in O_2, O_2^+, and NO arising from electronic excitation and ionization in molecular orbital theory, along with the corresponding force curves. Force curves are discussed for electronic states differing only in spin or orbital angular momentum; O_2 is used as an example. (D.L.C.)

18308

MIXED ORGANIC CRYSTALS FOR SCINTILLATION COUNTERS. G. S. Belikova and L. M. Belyaev (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst. 4, 886-7(1960) June.

The luminescence spectra of naphthalene crystals with additions of anthranilic acid, methyl anthranilate, 1,4-diphenylbutadiene, and 1,6-diphenylhexatriene were investigated. The entry of the impurity into the crystal is shown by the variation in the luminescence spectra and luminous emission as a function of the concentration of the addition. (B.O.G.)

18309

ENERGY TRANSFER AND DECAY TIMES IN RADIATION-INDUCED LUMINESCENCE OF BENZENE SOLUTIONS. Milton Burton and Herbert Dreeskamp (Univ. of Notre Dame, Ind.). Z. Elektrochem. 64, 165-9(1960). (In English)

A previously described technique for precise measurement of luminescence decay times in the range around 10^{-9} sec was slightly modified to permit more exact interpretation of the data. The results for a system of aerated benzene containing p-terphenyl scintillator were analyzed to indicate two decay times τ_1 and τ_2 as governing parameters of the shape of the luminescence decay curves. The value of τ_1 is a variable nonlinear function of scintillator concentration and is assigned to the excited state of the solvent. In absence of scintillator τ_1 for excited benzene is $\sim 2 \times 10^{-8}$ sec. The value of τ_2 is fixed at 2.2×10^{-9} sec and appears assignable to the excited state of the scintillator. However, certain anomalies raise questions as to the propriety of such assignment. (auth)

18310

CONCERNING THE ENERGY DISTRIBUTION OF IONS FROM A HIGH FREQUENCY ION SOURCE. Günter Forst (Technische Universität, Berlin). Z. Physik 159, 7-18 (1960). (In German)

Experimental results showed that the energy distribution of hydrogen ions from a high-frequency source was substantially wider than predicted by the Langmuir theory. This behavior was also true of the ions of He, Ne, Ar, and Xe. The abnormal width of the energy distribution was explained essentially as caused by a change in potential of the ions in the discharge space. The change in potential of the hydrogen ions was detected by an arrangement consisting of a grid with variable potential and a cage with a thermo-element as energy indicator for the ions and neutral particles. The total energy, as well as the energy distribution, was measured with this arrangement. The measured ratio of the total energy of the ions to that of the neutral particles agreed satisfactorily with that calculated from the energy distribution of the ions. (M.C.G.)

18311

RELATION BETWEEN THE PARABOLIC AND SPHERICAL EIGENFUNCTIONS OF HYDROGEN. David Park (Williams Coll., Williamstown, Mass.). Z. Physik 159, 155-7(1960). (In English)

It is shown that the transformation coefficients relating the eigenfunctions of the Kepler problem in parabolic and spherical coordinates respectively are the normalized Clebsch-Gordan coefficients. (auth)

18312

ON THE THEORY OF FORCE-FREE MAGNETIC FIELDS. E. Richter (Universität, Kiel). Z. Physik 159, 194-211 (1960). (In German)

Force-free magnetic fields are defined by the equation rot $H = \alpha H$. Making use of a moving Frenet coordinate system (t = tangential, n = normal, b = binormal unit vector) the following general features of these fields were found: 1. Grad $|H|$ was always parallel to the osculating plane of the H-lines. 2. If the lines of force are rectilinear within a finite region of space, the component of grad $|H|$ along H must be zero for a force-free field with rot $H \neq 0$. 3. The factor of proportionality $\alpha = \alpha(r)$ and $|H|$ can be calculated by means of two equations involving only

the direction of H. For several models of force-free fields, the effect of symmetry assumptions on $\alpha = \alpha(r)$ is discussed using special coordinate systems. It is pointed out that a particle drift arises in magnetic fields with $\alpha \neq 0$. (auth)

18313

THE TEMPORAL DEVELOPMENT OF A TOWNSEND DISCHARGE. H. Schlumbohm (Universität, Hamburg). Z. Physik 159, 212-22(1960). (In German)

Oscillographic studies of the current of a Townsend-discharge—started by 10^3 to 10^5 electrons within some mμsec—demonstrated the temporal development of the discharge in separated generations of electrons. Experiments were made in N_2, CH_4, CO_2, and mixtures of N_2/CH_4, and Ar/Air (gap-length 1.8 to 3 cm, pressure 50 to 400 mm Hg). A careful curve-fitting with calculated currents proved the agreement between measured and calculated curves. This correspondence showed that the discharge is governed by ionization by collisions and secondary-photo-effect at the cathode. (auth)

18314

THERMO-ELASTIC CONSTANTS OF THE ALKALI HALIDES OF THE NaCl TYPE. S. Haussühl (Universität, Tübingen, Ger.). Z. Physik 159, 223-9(1960). (In German)

Thermo-elastic constants were measured on 15 alkali halides of the NaCl type with ultrasonic methods. The constants show only small variations within the crystal group and may therefore be regarded as typical for NaCl type crystals. (auth)

18315

QUANTUM OSCILLATIONS OF THE PHOTOELECTRIC YIELD OF METALS IN A MAGNETIC FIELD. G. E. Zil'berman and I. O. Kulik. Zhur. Eksptl'. i Teoret. Fiz. 38, 1188-1200(1960) Apr. (In Russian)

Quantum oscillations of the volume (external) photoelectric effect in metals in a magnetic field are investigated in the ultraviolet region of the spectrum for electrons possessing an arbitrary dispersion law. Besides oscillations of the de Haas—van Alfvén type the expression for the photocurrent contains some new terms which are characteristic of other optical phenomena. It is shown that a study of the photocurrent oscillations and photoelectron energy distribution function permits one in principle to determine the shape of the Fermi surface as well as the arrangement of separate electron groups in the inverse lattice and to determine the shape of isoenergetic surfaces lying below the Fermi surface. The calculation is performed for the case when the magnetic field is perpendicular to the surface. The influence of photoelectron collisions prior to exit from the metal on oscillations of the photoelectron yield is considered. (auth)

18316

THEORY OF THERMAL STRESSES. Bruno A. Boley and Jerome H. Weiner. New York, John Wiley & Sons, Inc., 1960. 599p. $15.50.

Available techniques are described for determining stresses produced in a solid object when it is subjected to specified heating conditions. Thermal stress is explained through the basic subjects of thermodynamics, heat-transfer theory, elasticity, and inelasticity. A self-contained review of heat-transfer theory is given which includes a discussion of methods of problem formulation and solution. Methods of practical thermal-stress analysis, utilizing strength of materials approximations, are treated in both the elastic and inelastic domains. (B.O.G.)

Astrophysics and Cosmology

18317

NUCLEAR COSMOCHRONOLOGY. William A. Fowler and F. Hoyle (California Inst. of Tech., Pasadena). Ann. Phys. (N.Y.) 10, 280-302(1960) June.

Quantitative use is made of the radioactive decays of uranium and thorium in cosmochronology in much the same manner as these decays have been employed in geochronology. Two quite different views are presented: Model 1. The Autonomous Galaxy. From its origin, the Galaxy was an autonomous system—no further important additions of material from intergalactic space have taken place at subsequent times. Star formation, stellar evolution, and nucleosynthesis have declined at a steady exponential rate over the whole lifetime of the Galaxy. The duration of nucleosynthesis is found to be independent of this rate over rather wide limits. Model 2. Steady-State Cosmology and Galactic-Intergalactic Exchange of Matter. The abundance of the elements in intergalactic matter has reached a steady state through interchange with galaxies in which stars produce elements beyond hydrogen. As a consequence of this same point of view, the Galaxy acquired significant quantities of intergalactic material at various times. This occurred particularly about one billion years before the sun and solar system were formed. Except at epochs of addition of new gas, stellar activity has declined exponentially, as in Model 1. Consideration of the decay of the radioactive isotopes Th^{232}, U^{235}, U^{238}, according to Model 1, leads to the conclusion that the age of the Galaxy is $15^{+5}_{-3} \times 10^9$ years. Similar considerations according to Model 2 lead to the conclusion that the expansion time scale of the universe (the reciprocal of the Hubble constant H) is $11 \pm 6 \times 10^9$ years. The error can be reduced to $\pm 2 \times 10^9$ years if the present thorium—uranium ratio is chosen to give a Pb^{208}/Pb^{206} age for the solar system concordant with that given by Pb^{207}/Pb^{206}, namely 4.5×10^9 years. Applications to the chronology of the Galaxy can no longer be made in a simple manner but the age found in the Model 1 calculations would seem to be a lower limit. (auth)

18318

HELIUM, NEON AND ARGON ISOTOPES IN SOME IRON METEORITES. O. A. Schaeffer and J. Zähringer (Brookhaven National Lab., Upton, N. Y.). Geochim et Cosmochim. Acta 19, 94-9(1960) Apr. (In English)

The cosmic ray produced He^3, He^4, Ne^{20}, Ne^{21}, Ne^{22}, Ar^{36}, and Ar^{38} were measured in seven iron meteorites with varying helium contents. The results on isotope abundance agree well with previous results. By considering the He^3/He^4, He^3/Ne^{21}, and He^3/Ar^{38} ratios it is shown that it may be possible to determine the depth at which a sample was in the original meteoroid from these ratios, rather than from the absolute amount of any particular isotope. (auth)

18319

SELENIUM AND TELLURIUM CONTENT OF STONY METEORITES BY NEUTRON ACTIVATION. U. Schindewolf (Univ. of Michigan, Ann Arbor). Geochim et Cosmochim. Acta 19, 134-8(1960) Apr.

By neutron activation analysis the Se- and Te-contents of four chondritic meteorites were determined. The average content is 9.8 ± 2.5 and 0.61 ± 1.7 ppm, respectively. These values are lower than those already reported in the literature. (auth)

18320

EXPERIMENTAL AND THEORETICAL RESULTS ON NU-

CLEAR REACTIONS IN STARS. [PART] II. William A. Fowler (California Inst. of Tech., Pasadena). Mém. soc. roy. sci. Liège (5) 3, 207-23(1960). (In English)

The experimental and theoretical results on nuclear reactions in stars, first presented in 1953, have been extended and revised several times. The present results are given to bring the results up to date on the proton-proton chain, the CNO-cycle, the Ne-Na-cycle, and the $He^4 \rightarrow C^{12}$ process. Modifications have arisen primarily from new experimental determinations of reaction cross sections. (B.O.G.)

18321

NEUTRON STAR MODELS. A. G. W. Cameron (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Mém. soc. roy. sci. Liège (5) 3, 461-5(1960). (In English)

An equation of state for a neutron gas, derived from the work of T. H. R. Skyrme, is given. Relativistic forms of the terms in the equation were not used. At densities of $>10^{15}$ g/cc where relativistic terms would be important, this equation is not expected to be valid. The general relativistic equations of hydrostatic equilibrium are given for which there are no solutions for proper masses in excess of three stars. It does not appear likely that much more than one star mass will condense to form a neutron star in a supernova explosion, and stable solutions should exist for such a case. (B.O.G.)

18322

AN EVOLUTIONARY SEQUENCE OF SOLAR MODELS WITH REVISED NUCLEAR REACTION RATES. R. L. Sears (Indiana Univ., Bloomington). Mém. soc. roy. sci. Liège (5) 3, 479-89(1960). (In English)

The results are given from computations of an evolutionary sequence of solar models, with possibilities for completion of the p-p chain simultaneously taken into account. The length of time necessary to evolve the model, which represents the present sun, from the homogeneous one is 8×10^9 years. The presently accepted age of the solar system is 4.5×10^9 years. The evident discrepancy can be removed by a different choice for the initial composition of the homogeneous model. It is emphasized that the changes needed to fit any reasonable age are well within the uncertainties of the spectroscopically determined composition. (B.O.G.)

Cosmic Radiation

18323 AEC-tr-4114

ABSORPTION MEASUREMENT OF COSMIC RADIATION USING SCINTILLATION COUNTER. Ch. Burckhardt. Translated by Lydia Venters (Argonne National Lab.) from Helv. Phys. Acta 29, 533-44(1956). 11p. JCL.

Absorption of the star-producing component of cosmic radiation in thick materials was measured using a scintillation counter. Sheets of crude iron and ingot steel were used as absorbers. An integral pulse spectrum was taken of the ionizing events in the NaI—Tl crystal in the energy range 5 to 300 Mev. Transition effects induced by both charged and neutral particles were observed. (M.C.G.)

18324

COSMIC RADIATION IN THE INTERNATIONAL GEOPHYSICAL YEAR. R. Steinmaurer (Universität, Innsbruck, Austria). Acta Phys. Austriaca 13, 224-30(1960). (In German)

The first results obtained during the geophysical year on the relationship between solar activity and cosmic radiation are summarized. The solar intensity increases observed during this period are tabulated. Observations confirmed that between cosmic intensity and solar activity an antiparallel trend exists. The maximum cosmic intensity during the day was in the morning hours from 1954 to 1956. The radiation belts surrounding the earth are mentioned. (J.S.R.)

18325

RADIATION DANGER IN SPACE. Hermann J. Schaefer (U. S. Naval School of Aviation Medicine, Pensacola, Fla.). Astronautics 5, No. 7, 36; 42; 44-5(1960) July.

The characteristics of the Van Allen radiation belt as regards their probable effects on living tissues are discussed. A nuclear emulsion package recovered by Fredan and White from a missile nose cone covered the belt up to an altitude of 1230 km (lower fringes of belt) and enables estimates to be made for the tissue ionization dosage and depth dose pattern. Only protons with energy more than 80 Mev could penetrate the nose cone to the emulsion, and their energy spectrum and rate of energy loss vs. depth in tissue (Bragg curve) are plotted. The energy spectrum was converted into a range spectrum (in tissue) together with extrapolation into the low-energy end (80 to 45 Mev), and it is seen that the steep maximum characteristic of the Bragg curve disappears in a spherical tissue target. The "hardening" of the proton beam in the Van Allen belt and the extrapolation of Fredan and White's data to higher altitudes are discussed. The differences of the Van Allen proton beam from neutron-produced recoil protons are emphasized. (D.L.C.)

18326

THE RELATIVE ABUNDANCES OF COSMIC RAY NUCLEI OF CHARGE $Z \geq 3$. I. J. van Heerden and B. Judek (National Research Council, Ottawa). Can. J. Phys. 38, 964-7 (1960) July.

A stack of 72 Ilford G5 stripped emulsions, 12 in. × 9 in. × 600 μm, was flown from Brownwood, Texas (geomagnetic latitude, 41°N), on March 9, 1958, for 7.5 hr at a ceiling height of 136,000 ft. The total amount of matter above the emulsion was 3.2 g/cm^2. All the emulsions were scanned along a line 5 mm below the top edge for tracks with grain densities at least six times that at minimum ionization. A comparison was made of charge determination by gamma-ray density and gap density measurements. The value 0.20 ± 0.02 was obtained for the relative abundance of light nuclei in cosmic radiation. (M.C.G.)

18327

COMPARISON OF THE EMISSION OF NEUTRONS IN THE ATMOSPHERE AND THE EARTH CRUST. G. V. Gorshkov, S. P. Khormushko, and O. S. Tsvetkov (Khlopin Radium Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 933-5(1960) Apr. 1. (In Russian)

Neutron fluxes produced by α radiation over water and land were measured at Zelinogorsk, within 3 km of the Finnish Gulf, at 60.2° latitude; at the Zelinogorsk pier (2.5 m above water); and in the Leningrad subway, at ~200 m water equivalent. Tabulated data for neutron flux over water are in good agreement with the published data of 230 neutrons/cm^2 per day. The neutron flux over water was less than over land. It is postulated that neutron flux from rock is 5% less than the cosmic neutron flux at sea level, in good agreement with K. Mather (Austral. J. Phys. 9, 147(1956)) but in sharp disagreement with other authors. (R.V.J.)

18328

INVESTIGATION OF INTERPLANETARY IONIZED GAS, HIGH ENERGY ELECTRONS AND SOLAR CORPUSCULAR RADIATION BY MEANS OF THREE-ELECTRODE TRAPS FOR CHARGE-CARRYING PARTICLES INSTALLED ON

THE SECOND SOVIET SPACE ROCKET. K. I. Gringauz, V. V. Bezrukikh, V. D. Ozerov, and R. E. Rybchinskiĭ (Radio Technical Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1301-4(1960) Apr. 21. (In Russian)

Obtained data indicated the presence of plasma of not over tens of thousands of degrees at ~25,000 km from the earth up to 4 earth radii. An electron flux N of 10^8/cm^2/sec with energies exceeding ~200 ev was recorded at 55,000 < R < 75,000 km. Records show that the container passed through a positive ion flux (probably protons) with energies of 15 ev, N ~2×10^8/cm^2/sec. Identical positive collector currents were recorded by all four traps. The presence of proton fluxes with energies exceeding 25 ev were recorded at various times and at various distances from the earth (in particular at R ~125,000 km). The recorded proton fluxes are obviously solar corpuscular emissions observed for the first time in the interplanetary space outside the earth's magnetic field. (R.V.J.)

18329

DISTRIBUTION OF γ-QUANTUM ENERGY AT GROUND LEVEL. R. M. Kogan and Sh. D. Fridman (Inst. of Applied Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz. No. 4, 530-47(1960) Apr. (In Russian)

Calculations are made of the γ quantum energies at ground level and at elevations up to several hundred meters. A model stratum with radiation sources of uranium, thorium, and radioactive potassium uniformly distributed in the upper layer of mineral rock or radioactive elements with assigned γ quanta energy distributed as a fine homogeneous film on the interface between the rock and atmosphere were used in the experiment. The effects of γ-field action in some types of γ detectors are evaluated. (R.V.J.)

18330

OBSERVATIONS ON EXTENSIVE AIR SHOWERS. VIII. THE DISTRIBUTION IN DECLINATION AND CURVATURE OF THE SHOWER FRONT. E. F. Bradley and N. A. Porter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8) 5, 305-10(1960) Apr.

A directional Cherenkov counter was used at latitude 52° N to separate shower directions into two classes, incident from North and South of the East—West plane through the zenith. Evidence from some previous experiments indicated a Northern excess of approximately 30%. No excess was observed. Out of 526 showers, each containing at least 3×10^6 particles at sea level, 261 were incident from the North, and 265 from the South. The apparent direction of a shower was found to be dependent on the position of its axis relative to the detector. A directional radius of curvature was measured, making reasonable assumptions, and found to be $1625 \pm \frac{505}{280}$ meters. (auth)

18331

THE RELATIVE ABUNDANCES OF THE HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION. C. J. Waddington (Bristol Univ., Eng.). Phil. Mag. (8) 5, 311-23(1960) Apr.

In an attempt to resolve the present controversy about the relative abundances of the heavy, $Z \geq 6$, nuclei in primary cosmic radiation, the magnitude of the corrections introduced by the overlying atmosphere was redetermined. For this reason it was necessary to use nuclear emulsions to determine the fragmentation parameters of nuclei having $20 \leq Z \leq 28$. The results of this work show that the relative abundances calculated previously by considering the diffusion of nuclei through the atmosphere were not seriously in error, and that outside the atmosphere the ratio of H, $Z \geq 10$, to M, $6 \leq Z \leq 9$, nuclei is 0.38 ± 0.04. The significance of this result is considered briefly. (auth)

18332

COSMIC-RAY PRODUCTION RATES OF Be^7 IN OXYGEN, AND P^{32}, P^{33}, S^{35} IN ARGON AT MOUNTAIN ALTITUDES. Devendra Lal, James R. Arnold, and Masatake Honda (Scripps Institution of Oceanography, La Jolla, Calif.). Phys. Rev. 118, 1626-32(1960) June 15.

The production rates of radioisotopes P^{32}, P^{33}, and S^{35} in argon, and of Be^7 in oxygen were measured by exposing argon and water to cosmic rays at mountain altitudes for periods of two to four months during 1959. The measured values at $\lambda = 51°$ N, atmospheric depth 685 g cm^{-2} were 7.6×10^{-6}, 6.2×10^{-6}, 1.4×10^{-5} atoms (g argon)$^{-1}$ sec^{-1} of P^{32}, P^{33}, and S^{35}, respectively, and 9.0×10^{-6} Be^7 atoms (g oxygen)$^{-1}$ sec^{-1}. Isotope production rates for all regions in the atmosphere were recently calculated by Lal et al. The measured production rates were higher than the calculated rates by factors of 1.1, 1.8, 1.4, and 1.8 in the case of radioisotopes Be^7, P^{32}, P^{33}, and S^{35}, respectively. In this comparison, account was taken of the fact that cosmic-ray intensity decreased by about 15% since 1948, the time period to which the calculations apply. The measured production rates in oxygen were assumed to apply to air since cross sections for Be^7 formation were found to be the same in nitrogen and oxygen over most of the energy region of interest. The procedure used by Lal et al. yielded a fairly accurate picture of the variation in production rates with altitude and latitude in the atmosphere. Isotope production rates in all regions of the atmosphere could, therefore, be obtained by normalizing their calculations at the points where the measurements were made. The calculated production rates of these isotopes in the troposphere, and in the stratosphere corresponding to observed cosmic-ray intensity during 1948-49, were given. The available data on the concentration of the isotopes in rain-water and their averaged yearly deposition rates were compared with their revised production rates. From such a comparison, more definite conclusions could be drawn than hitherto possible in view of the more accurate knowledge of isotope production rates. (auth)

Criticality Studies

18333 AERE-C/R-1814

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

FUSED FLUORIDE FUEL SYSTEMS FOR HOMOGENEOUS REACTORS. PART IV. ESTIMATES OF CRITICAL SIZE. G. Long. Nov. 21, 1955. 16p. (RCTC/P.57)

The critical size of a spherical fused-fluoride reactor with graphite or beryllia moderator is calculated. The effect on the critical size of changing the nature and composition of the melt is discussed. The critical mass of U^{235} was found to be in the region of a few kilograms, and it was suggested that a fluoride system could be used as a small, high-temperature (>600°C) reactor. The chemical problems are outlined. (auth)

18334 LA-2026

Los Alamos Scientific Lab., N. Mex.

CRITICAL MASSES OF ORALLOY LATTICES IMMERSED IN WATER. J. C. Hoogterp, G. E. Hansen, H. C. Paxton,

and D. P. Wood. Nov. 1955. Decl. May 18, 1960. 55p. Contract W-7405-eng-36. OTS.

A solid cube of oralloy becomes critical at 24 kg when immersed in an infinite water reflector. Various critical lattices were obtained by dividing this solid shape into small units and uniformly dispersing them at various mean densities. For a given size of oralloy unit, there is a mean density at which the critical mass is a minimum. The H to U atomic ratio of the cores with minimum critical masses was determined. Measurements with nonuniformly dispersed oralloy do not indicate a critical mass below the minimum observed with a uniform lattice. Multiplication measurements with Au, Ag, and Cd rods inserted in the oralloy matrix yielded the effective cross section ratios: σ_a (Ag)/σ_a (Au) = 0.86, and σ_a (Cd)/σ_a (Au) = 1.58. These values are independent of position and lattice spacing for ranges examined. (auth)

Elementary Particles and Radiations

18335 AFOSR-TN-60-461

Miami. Univ., Coral Gables, Fla.

STUDY OF ANTIPROTON INTERACTIONS. M. Blau, C. F. Carter, and A. Perlmutter. Mar. 31, 1960. 17p. Contract AF49(638)-97.

A compilation of raw data obtained from the exposure of a stack of 200 Ilford G5 emulsions to a separated Bevatron beam of 620 Mev/c antiprotons is presented. The dimensions of the stack and the impossibility of tracing a large fraction of the fast annihilation products to their ends as well as the difficulty of making very good measurements on them cause the statistics to be small compared with other studies. (W.D.M.)

18336 AFSWC-TN-59-33

Air Force Special Weapons Center, Kirtland AFB, N. Mex.

X-RAY MASS ATTENUATION COEFFICIENTS IN THE 1.49 TO 11.9 KEV RANGE. C. E. Ehrenfried and D. E. Dodds. Jan. 1960. 66p. Project No. 7811.

Mass attenuation coefficients of eleven metals and three plastics were determined for fourteen x-ray energies from 1.49 to 11.92 kev. The sources of radiation were K_α emission from suitable fluorescers. The attenuation coefficients obtained for metals agree reasonably well with the compilation of Allen. The values for the plastics agree within 5 percent of calculated coefficients from Victoreen's data. Tables and graphs are given which show mass attenuation coefficients determined as well as values determined by several other investigators. (auth)

18337 CERN-60-13

European Organization for Nuclear Research, Geneva.

A KINEMATICS PROGRAMME FOR THE ANALYSIS OF PION-PROTON ELASTIC SCATTERING. G. R. Macleod. Mar. 29, 1960. 18p.

A program written for the Ferranti Mercury Computer at CERN, to make kinematic calculations on measurements of π-p scattering events in propane or hydrogen bubble chambers, is described. The photographs of the events were measured with digitized protractors. (W.D.M.)

18338 LAMS-2116

Los Alamos Scientific Lab., N. Mex.

SOLUTION OF THE INITIAL VALUE PROBLEM FOR THE LINEARIZED MULTI-VELOCITY TRANSPORT EQUATION WITH A SLAB GEOMETRY. George H. Pimbley. Jan. 30, 1957. 128p. Contract W-7405-eng-36. OTS.

The linearized Multi-Velocity Transport equation, a vector integro-differential equation arising in neutron transport theory, describes the behavior of neutrons as they diffuse through a medium subject to processes of scattering, capture, and fission. The special case where the medium is in the shape of an infinite homogeneous slab of material of thickness 2a is discussed. The initial value problem for the slab geometry gives the neutron behavior, subject to the boundary conditions on the free surfaces, for all subsequent time, relative to the given distribution at time t = 0. The multi-velocity treatment is explained, and the method derived from a much more general velocity-dependent form of the transport equation. After introduction of an appropriate Hilbert Space $\hat{H}$, the transport equation assumes the form $\partial\vec{N}/\partial t = A\vec{N}$, where A is a linear operator on $\hat{H}$ and $\vec{N}$ is the neutron distribution vector whose components are the neutron distributions for fixed velocity groups. Next, an attempt is made at characterizing the spectrum of the operator, A, which turns out to be neither bounded nor self-adjoint. Nevertheless, methods are developed which give the spectral decomposition. By using a variant of the Hille-Yosida Theorem on the existence of semi-groups, the solution of the n-velocity initial value problem is shown to exist, to be unique in $\hat{H}$, and to depend continuously on the initial data. This solution is represented as a line integral in the strong sense, with integration along a path in the resolvent set. The path of integration is shifted so as to collect residues from the point spectrum, whose points are first order poles of the resolvent. This yields a finite expansion in terms of eigenelements of A, plus a residual term resulting from the rest of the spectrum. (auth)

18339 NEVIS-68

Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.

SCATTERING OF MESONS BY NUCLEI (thesis). Hugh Byfield. Apr. 1958. 54p. Contracts N6-ori-110-Task No. I and AT(30-1)-1932. (CU-170-58-ONR-110-1-Phys.). OTS.

The differential scattering cross section for elastic scattering of 62 Mev π^- and π^+ on carbon was measured in a 16-in. Wilson cloud chamber, with magnetic field. Total cross sections were found for elastic and inelastic scattering and absorption. A qualitative examination of the data which show a pronounced nuclear-Coulomb interference led to the conclusion that the nuclear potential is attractive for pions. The data are analyzed by means of an exact partial wave analysis of an optical model, using an IBM-650 computer to solve the differential equations involved, to solve for the phase shifts, and to compute the angular distributions. Several nuclear models were examined. The complex potential $(V_1 + iV_2)$ using a square well distribution and using a diffuse edge distribution with differing well depths and shape parameters failed to produce a fit to more recent elastic data at 80 Mev. A Kisslinger model which takes into account the elementary pion-nucleon p-wave process was found to give a good fit, provided the model was altered to eliminate an instability in the differential equation. The density function was taken to be a Fermi expression as used by Woods and Saxon. The shape parameters for best fit were $R_0 = 1.08A^{1/3}$ and a = 0.25. Complex interaction parameters C′ and C could be derived from the elementary pion-nucleon scattering amplitudes. The predicted set of C and C′ failed to give a fit. The best fit was obtained with an empirically determined set: $C = -1.1 - 0.1\,i$, $C' = +0.35 - 0.15\,i$, using the data at 80 Mev. An

empirically determined set of interaction parameters provided a fit at 62 Mev for both positive and negative pion data. It also provided a fit to the 80 Mev data for Li and Al. (auth)

18340 NP-8693
Maryland. Univ., College Park.
ABSORPTION MECHANISMS OF NEGATIVE K MESONS AND PIONS IN LIQUID HYDROGEN. Thomas B. Day. Apr. 1960. 19p. Contract AF49(638)-24. ([AFOSR]-TN-60-501).

Slowing down and capture of negative mesons by the atoms and molecules in liquid hydrogen are treated. The results of an experiment on following 80,000 pion tracks stopping in a liquid hydrogen bubble chamber are discussed. The question of from which atomic state the meson is absorbed is considered. (W.D.M.)

18341 NP-8708
Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy.
PRODUCTION OF A $\tilde{\Sigma}^-$-HYPERON BY 8.3 Bev/c NEGATIVE PIONS. Kan-chang Wang, Tsu-Tzien Wang (Tzu-tzen Wang), V. I. Veksler, N. M. Viryasov, I. Vrana, Da-tsao Din Da-tzao Ding), Hi-in Kim, E. N. Kladnitzkaya, A. A. Kuznetzov, A. Michul, Ting-ty Nguen (Dinh-tu Nguyen), A. V. Nikitin, and M. I. Solov'ev (Soloviev). 1960. 7p. (D-508)

An event of $\tilde{\Sigma}^-$-hyperon production and decay was found in the course of scanning 40,000 propane bubble chamber photographs which were taken in a steady magnetic field of 13,700 gauss. A beam of 8.3-Bev/c negative pions was used. The event is analyzed, and the kinematics at different points in the photograph are given. (W.D.M.)

18342 TID-5887
Maryland. Univ., College Park and Wisconsin. Univ., Madison.
ON THE LEPTONIC AND NON-LEPTONIC DECAY-MODES OF K-MESON. Technical Report No. 171. J. C. Pati, S. Oneda, and B. Sakita. Apr. 1960. 37p. Contracts AF49(638)-24 and AT(11-1)-30. ([AFOSR]-TN-60-455). OTS.

An attempt is made to explain the branching ratios of the various leptonic and nonleptonic modes of K-meson decays in the framework of V-A four-fermion interaction, extended to the tetrahedron scheme. The nonleptonic modes were investigated with the inclusion of a new class of diagrams for $\Lambda \rightarrow N + \pi$-decays, satisfying the strict $|\tilde{\Delta}I| = \frac{1}{2}$-rule. Final state π-π interactions were neglected. It is shown that all the relative rates (involving ratios between different decay rates) can be explained reasonably well (at least as far as the order of magnitude is concerned), if it is assumed that the matrix element for any process, evaluated by perturbation theory, should be damped by a factor $\approx \sqrt{3}$, whenever a π is emitted from a closed baryon-antibaryon loop. The observed features of the approximate $|\tilde{\Delta}I| = \frac{1}{2}$-rule in the nonleptonic modes of K-meson decays become easy to understand by showing the marked importance of the new class of diagrams for $\Lambda \rightarrow N + \pi$-decays, which enter as virtual processes for K-meson decays. It is also possible to explain the fact that the final state in $K^+ \rightarrow \pi^+ + \pi^- + \pi^+$-decay is predominantly symmetric between the three pions. (auth)

18343 TID-5930
Wisconsin. Univ., Madison.
COULOMB DISINTEGRATION OF BEAM PARTICLES. M. L. Good and W. D. Walker. [1960]. 10p Contract AT(11-1)-64. OTS.

Momentum transfer accomplished by a Coulomb field was found to enable a particle of mass M to make a transition into a state of mass M* and then stay in that state a time of the order $2P/(M^{*2}-M^2)$ where P is momentum. The consequences of the long lifetime of the intermediate stages were studied for several elementary particles. Physically, the process was a photodisintegration of beam particles and it allowed unstable particles to be used as a target. (M.C.G.)

18344 TID-5931
Wisconsin. Univ., Madison.
PHOTODISSOCIATION OF THE Mu MESON. M. E. Ebel and W. D. Walker. [1958]. 6p. Contracts AT(11-1)-30 and AT(11-1)-64. OTS.

The cross section for the production of a charged vector boson by the dissociation of a high-energy muon beam undergoing Coulomb scattering was calculated. The cross section for such a process is 1 to 3×10^{-34} cm^2 in Pb. Possible experiments for the detection of such decays are discussed. (auth)

18345 TID-6103
Nebraska. Univ., Lincoln.
ENERGY AND ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS PRODUCED BY PROTONS IN GASES. Chris E. Kuyatt. [1958?]. 38p. Contract AT(11-1)-35. OTS.

The energy distribution of secondary electrons produced at various angles by the passage of protons through hydrogen and other gases was measured. Energy distributions were obtained for electrons released at 23, 45, 67½, 90, 112½, 135, and 150° by 50, 75, and 100 kev protons incident on hydrogen gas. The distributions were given in terms of differential cross sections which were plotted, for several electron energies, as a function of the angle the electron made with the proton beam. Some Born approximation calculations were also made for ionization in proton—hydrogen atom collisions. (M.C.G.)

18346 UCRL-5886
California. Univ., Livermore. Lawrence Radiation Lab.
TABLE OF CONVERSION OF SCATTERING ANGLES FOR PROTON-PROTON SCATTERING. Bradley M. Johnston and Michael J. Moravcsik. Feb. 12, 1960. 203p. Contract W-7405-eng-48. OTS.

A table which facilitates the conversion of scattering angles from the laboratory to the center-of-mass system for proton-proton scattering is given. (M.C.G.)

18347 UCRL-9048
California. Univ., Berkeley. Lawrence Radiation Lab.
CHARGE-EXCHANGE SCATTERING OF NEGATIVE PIONS BY HYDROGEN AT 230, 260, 290, 317, and 371 MEV (thesis). John C. Caris. Mar. 18, 1960. 105p. Contract W-7405-eng-48. OTS.

The differential cross section for charge-exchange scattering of π^- by H was observed at 230, 260, 290, 317, and 371 Mev. The reaction was observed by detecting one gamma ray from the π^0 decay with a scintillation-counter telescope. A least-squares analysis indicates that d-wave scattering is not established in this energy range. (auth)

18348 UCRL-9119
California. Univ., Berkeley. Lawrence Radiation Lab.
THE ELASTIC SCATTERING OF NEGATIVE PIONS BY PROTONS AT 230, 290, 370, AND 427 MEV (thesis). Lester K. Goodwin. Apr. 7, 1960. 84p. Contract W-7405 eng-48. OTS.

The elastic differential cross section for the scattering of π^--mesons by hydrogen was measured at laboratory kinetic energies of 230, 290, 370, and 427 Mev. The elas-

tically scattered pions were detected by a counter telescope which discriminated against recoil protons and inelastic pions on the basis of their shorter ranges. Nine differential-cross-section points obtained at each energy were fitted by a least-squares program to a Legendre polynomial series. At the three higher energies, D waves are required to give a satisfactory fit to the data. The real part of the forward-scattering amplitudes calculated from the data are in agreement with the predictions of dispersion theory. The results in conjunction with data from other $\pi-N$ scattering experiments support charge independence at these higher energies. (auth)

18349 NP-tr-334

Joint Inst. for Nuclear Research, Dubna, U.S.S.R., Lab. of Nuclear Problems.

PION PRODUCTION IN THE INTERACTIONS OF 280 MEV π^+-MESONS WITH PHOTOEMULSION NUCLEI. This is an English version of paper published in Doklady Akad. Nauk S.S.S.R. 128, 491-4(1959). Yu. A. Batusov, N. P. Bogachev, V. M. Sidorov, and I. Ciulli. 1959. 13p. (P-335). JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 2893.

18350

GREEN'S FUNCTION FOR THE INTEGRAL-DIFFERENTIAL OPERATOR OF THE STATIONARY NEUTRON TRANSPORT THEORY. G. F. Kohlmayr (Technische Hochschule, Graz). Acta Phys. Austriaca 13, 300-14(1960). (In German)

The stationary neutron field in material media can be described by a linear partial inhomogeneous integro-differential equation. It is treated as a finite system so that one can formulate an eigenvalue problem in the case of absent foreign source. In the present work the fission neutron number was used as suitable parameter in neutron propagating media. From the neutron balance of the time reversal transport process the adjunct transport equation is obtained. The Green's functions of the transport and adjunct transport equation satisfy a reciprocal relation. The eigen solution fields, connected by an orthogonal relation, of the transport and the adjunct transport equation were used for a formal bilinear series representation of the Green's function of the transport operator. The Green's function makes possible an exact formulation of the criterion problem and can serve as initial point for the solution of boundary value problems with inhomogeneous boundary conditions. (tr-auth)

18351

EXPLANATION OF THE ELECTRON-MUON MASS DIFFERENCE. Herbert Pietschmann (Universität, Vienna). Acta Phys. Austriaca 13, 315-17(1960). (In German)

It has been proposed that the mass difference between the electron and the muon can be explained by the coupling of a hypothetical isoscalar boson field with 0 spin onto the muon field. This unobserved field quantum has been called the σ meson. It can be assumed that by the recoil in the emission of the virtual σ meson an additional motion of the charge center of gravity occurs, which produces an abnormal magnetic moment. The problem is to determine if it is possible by a suitable choice of the coupling constant and mass of the σ meson to increase the mass by 20,000%, but to keep the magnetic moment unchanged within the narrow limits of error. Four cases were discussed in minimum, non-oscillatory perturbation-theory approximation: scalar and pseudoscalar σ mesons with direct and with gradient coupling. (J.S.R.)

18352

APPLICATION OF DISPERSION RELATIONS TO NUCLEON-NUCLEON SCATTERING: THE TWO-PION CONTRIBUTION. Marvin L. Goldberger (Princeton Univ., N. J.) and Reinhard Oehme (Univ. of Chicago). Ann. Phys. (N.Y.) 10, 153-70(1960) June.

The two-pion contribution to the amplitude for nucleon-nucleon scattering is computed in terms of the invariant amplitudes which characterize the four-body Green's function of the pion nucleon system. The dependence of this contribution upon the momentum transfer of the two-nucleon system is completely exhibited. A general method is described for the derivation of symmetry properties for the invariant coefficients in the expansion of the scattering amplitude in spinor space. (auth)

18353

EFFECTS OF THE PAULI PRINCIPLE ON THE SCATTERING OF HIGH-ENERGY ELECTRONS BY ATOMS. Marvin H. Mittleman (Univ. of California, Livermore) and Kenneth M. Watson (Univ. of California, Berkeley). Ann. Phys. (N.Y.) 10, 268-79(1960) June.

Some consequences of the Pauli principle for the elastic scattering of electrons by atoms are studied. The contributions both from the exchange integrals and from the Hartree-Fock condition that the scattered wave be orthogonal to the bound-state wave functions are expressed in a simple approximate form. For high-energy electrons these corrections are very small. (auth)

18354

THE PHENOMENOLOGICAL REPRESENTATION OF $\bar{K}$-NUCLEON SCATTERING AND REACTION AMPLITUDES. R. H. Dalitz and S. F. Tuan (Univ. of Chicago). Ann. Phys. (N. Y.) 10, 307-51(1960) July.

An explicit parametrization of the $\bar{K}$-N scattering and reaction amplitudes, satisfying the unitarity conditions and including the implications of time-reversal invariance, is given in terms of the elements of a suitably-defined reaction (or K-) matrix. Plausible approximations then lead to the formulas of a "zero-range" theory, an extension of that introduced by Jackson et al., in which all the low-energy $\bar{K}N$ cross sections are expressed in terms of two complex scattering amplitudes (A_0, A_1), a phase angle ϕ_t and a real parameter ϵ. The zero-energy and 175 Mev/c K^--p data allow four possible sets (a±), (b±) of these parameters; the Coulomb-nuclear interference in K^--p scattering favors (a+) and (b+). The most important qualitative conclusion based on this formalism is that the data indicates that the KYN coupling is so strong that perturbative methods are in general quite inadequate for the calculation of K-particle processes. The relationship of pion-hyperon (πY) scattering cross sections with the $\bar{K}N$ data is discussed in detail and it is shown that the parameter sets (a–) or (b–) would require the existence of a πY resonant state not far below the K^--p threshold. After determination of expressions for the $\bar{K}N \rightarrow \pi Y$ amplitudes, the energy dependence of the Σ^-/Σ^+ and Λ/Σ^0 ratios are discussed, together with some remarks on the $K^-p \rightarrow \Lambda\pi\pi$ cross section. The Coulomb corrections to the nuclear K-matrix elements are derived, as well as the modification of the corresponding T-matrix elements by the $K^- - \bar{K}^0$ mass difference through the unitarity condition. These corrections are far from negligible and lead to appreciable modification of the parameter sets (a±), (b±). Each of these sets fits the Σ^-/Σ^+ ratios at zero energy and in the range 100 to 200 Mev/c; the (a+) and (b–) sets require a strong upward cusp in this ratio at the $\bar{K}^0$-n threshold, the (a–) and (b+) sets a downward S-shaped cusp. Taking all the present data together,

the (a+) set appears favored. A brief discussion of the advantages and disadvantages of the K-matrix formalism is given in the Appendix. (auth)

18355

THEORY OF LOW-ENERGY SCATTERING IN FIELD THEORY. M. Cini and S. Fubini (European Organization for Nuclear Research, Geneva). Ann. Phys. (N. Y.) 10, 352-89(1960) July.

An approximate representation for the scattering amplitude of processes with two final particles, expected to be valid below the threshold for anelastic production of new particles, is deduced from the Mandelstam double integral representation. The principle underlying this reduction is that only the contributions from the singularities of the scattering amplitude near the physically interesting range of the variables need to be taken correctly into account, while the contributions from distant singularities can be expressed in the form of polynomial expansions. This means that anelastic processes are neglected in the unitarity condition of the S matrix, and their effects lumped into arbitrary constants. The method leads to systems of coupled nonlinear integral equations for the lowest angular momentum partial waves of the different reactions described by the same amplitude. These equations coincide, for the problem of pion-pion scattering, with those found by Chew and Mandelstam with a different procedure. Meson-nucleon and nucleon-nucleon scattering are then investigated by means of a model in which all particles are neutral and spinless. In the first problem one obtains a generalization of the equations found by means of fixed momentum transfer dispersion relations, in which the effect of a possible strong pion-pion interaction is included. For nucleon-nucleon scattering the contribution of the two meson exchange to the scattering amplitude is expressed in terms of pion-pion and pion-nucleon amplitudes. This should be sufficient for the determination of most of the nucleon-nucleon phaseshifts, apart possibly from a few parameters (scattering lengths and effective ranges) of the lowest ones which depend critically on the higher mass states. The possibility of constructing a two-meson exchange static potential is also demonstrated. (auth)

18356

THE RELATIVISTIC MOTION OF A CHARGED PARTICLE IN AN INHOMOGENEOUS ELECTROMAGNETIC FIELD. Peter O. Vandervoort (Univ. of Chicago). Ann. Phys. (N. Y.) 10, 401-53(1960) July.

The guiding center approximation for the relativistic motion of a charged particle in a nonuniform electromagnetic field is treated by a method which exhibits the nonconstancy of the adiabatic invariant. The position of the particle is expressed in terms of variables which represent the gyration and the motion of the guiding center, respectively; the equations which govern these variables are derived. The equation for the gyration is solved by an iteration method, and the solution is carried to the second approximation. In special cases, this solution suffices to determine the change in the adiabatic invariant. The adiabatic invariant is interpreted as the relativistic analog of the magnetic flux enclosed by the Larmor orbit. In each approximation, the equation for the motion of the guiding center is derived. An integral of this equation expresses the invariance of the square of the four-velocity. A systematic method is described for solving the equation for the motion of the guiding center in the case that the electric and magnetic fields are almost mutually perpendicular. (auth)

18357

MAGNETO-OPTICAL ROTATION IN VERY HIGH FIELDS. Richard Stevenson (McGill Univ., Montreal). Can. J. Phys. 38, 941-4(1960) July.

Magneto-optical rotation by transmission through or reflection from solids is examined by the classical free electron theory, with the view of taking such a measurement using fields in the megagauss range. In general the rotation is a markedly non-linear function of the magnetic field, and in some cases can change in sign as the field increases. For very low fields the rotation varies directly with B, but in the high field limit the rotation varies inversely with the field. For substances in which the intercollision time of the electron is small, measurements of the Kerr rotation (i.e., by reflection) will give the electron mobility as a function of the magnetic field, and thus will give important data which can be used in conjunction with high field magnetoresistance experiments. (auth)

18358

AZIMUTHAL ASYMMETRY IN SCATTERING OF DIRAC'S PARTICLES. R. M. Muradyan (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 1057-9(1960) Apr. 11. (In Russian)

The angular distribution of a partially polarized beam of Dirac particles was calculated for arbitrary spherically symmetric potential. (R.V.J.)

18359

DETERMINATION OF THE g-FACTOR FROM COMPARISON OF THE FREQUENCIES OF THE PARAMAGNETIC AND CYCLOTRONIC ELECTRON RESONANCES. V. N. Lazukin (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 1064-6(1960) Apr. 11. (In Russian)

A facility was designed for studying the properties of cyclotron resonance absorption of free electrons. The method affords a direct visual observation of the absorption line and reveals the influence of certain factors on its shape. Electron cyclotron resonance lines and paramagnetic spin resonance lines were studied and compared under identical conditions. The observations confirmed the theoretical postulation on the width and shape of the cyclotron resonance absorption lines as functions of time, electron interactions with the radiation field, density and energy of the electron beam, interaction collisions with residual gas molecules, and microwave oscillation forces in the resonator. (R.V.J.)

18360

ON THE MASS SPECTRUM AND THE FUNDAMENTAL LENGTH IN FIELD THEORY. V. G. Kadyshevskii (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 1305-7(1960) Apr. 21. (In Russian)

Existing field theory does not possess a constant length dimension; consequently the masses of elementary particles cannot be measured. However, some information on mass spectra can be obtained by utilizing the properties of a group of automorphisms in order to show that if the system of all one-part amplitudes transforms according to the irreducible Lorentz group, then the mass of the system is a continuous parameter. (R.V.J.)

18361

ABSORPTION OF GAMMA-RADIATION FROM A POINT SOURCE BY MACROSYSTEMS. A. K. Breger, B. I. Vainshtein, L. S. Guzei, Yu. S. Ryiabukhin, and N. P. Syrkus (Karpov Scientific-Research Inst. of Physics and Chemistry, USSR). Doklady Akad. Nauk S.S.S.R. 131, 1308-11 (1960) Apr. 21. (In Russian)

A method is offered for measuring γ absorption from a

point source by large objects. Cases in which the point source is placed at the center of a sphere and on the axis of a cylinder are analyzed. In the latter case, absorption can be recorded from two sides of the cylinder divided by a plane passing through the point source and perpendicular to the cylinder axis. This holds true for absorption of both initial and scattered radiation. The total absorption in the cylinder is the sum of absorption from all parts of the cylinder. The results yield not only the magnitude of the absorbed energy but also the magnitude of the newly introduced accumulation factor of the integral energy flux (B_f), which indicates what part of the radiation is emitted from the absorber as scattered radiation. The magnitude of B_f can be further used for calculating energy absorption with sources and absorbers of various configurations. (R.V.J.)

18362

BOUNDARY LAYER IN RADIATION AND ABSORPTION MEDIA. A. N. Rumynskiĭ. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr. No. 2, 47-53(1960) Mar.-Apr. (In Russian)

The boundary layer is analyzed with considerations for radiation. A system of approximate differential equations is derived which excludes unknown ray characteristics. A solution is obtained for the laminar interface layer in plane lamina (with viscosity of $\mu\rho$ = const.) systems. The results hold for mixed and specific emissions. (R.V.J.)

18363

NUMERICAL INTEGRATION OF THE TRANSPORT EQUATION WITH NO ANGULAR TRUNCATION. Herbert S. Wilf (Univ. of Illinois, Urbana and Argonne National Lab., Ill.). J. Math. Phys. 1, 225-30(1960) May-June.

For any given azimuth-independent scattering law, it is shown that the neutron transport equation with external source is rigorously equivalent to a coupled system of Fredholm integral equations. These are derived both for vacuum and periodic boundary conditions. A numerical integration scheme is given for solving these integral equations with no angular truncation error, thereby permitting the solution of the Boltzmann equation numerically with no error but that in the spatial integration. All cross sections are permitted to be arbitrarily given functions of position if desired. (auth)

18364

NON-CONSERVATION OF PARITY IN WEAK INTERACTIONS (REVIEW). A. P. Rudik. Kernenergie 1, 210-15 (1958) Mar. (In German)

The theoretical and experimental studies of parity conservation in weak interactions are reviewed. The effects of non-conservation according to Lee and Yang are pointed out, and other theoretical studies on the effects on other conservation laws are discussed. The experimental studies reviewed include: angular distribution of electrons in β decay of polarized nuclei, angular asymmetry in π-μ-e decay, dependence of angular asymmetry of π-μ-e decay on energy, and polarization of electrons in β decay. (T.R.H.)

18365

MEASUREMENT OF THE THERMAL NEUTRON DIFFUSION LENGTH IN ICE. L. M. Barkov, V. K. Makar'in, and K. N. Mukhin (Muchin). Kernenergie 1, 384-5(1958) May. (In German)

Density distribution measurements were made in an ice block 100 × 100 × 130 cm for neutrons from an Sb–Be source. For –14°C, L was 2.85 ± 0.05 cm for an ice density of 0.89 ± 0.01 g/cm^3. (T.R.H.)

18366

BACKSCATTERING OF γ RADIATION. U. A. Ulmanis and N. A. Dubinska (Dubinskaja). Kernenergie 1, 389-90(1958) May. (In German)

Gamma backscattering in different substances was studied. A γ scintillation spectrometer with a 30-mm-diam. NaI crystal 15 mm high was used. Its resolving power was 15% for the 320-kev line of Cr^{51}. A 1 μc source of Cr^{51}, Cs^{137}, and Co^{60} was used. Absorbers were thin plates of Al, Fe, Zn, Cd, Pb, brass, and paraffin. The results obtained are presented and discussed. (T.R.H.)

18367

THE PION-NUCLEON COUPLING CONSTANT. T. D. Spearman (St. John's Coll., Cambridge, Eng.). Nuclear Phys. 16, 402-4(1960) May (2). (In English)

The sum rule obtained by taking the limit of infinite energy in the π–p forward scattering dispersion relation was used to obtain a value for the renormalized coupling constant $f^2 = 0.078 \pm 0.008$, which is in good agreement with the values obtained from other methods. (auth)

18368

KINETIC AND POTENTIAL ENERGY MATRIX ELEMENTS FOR THE TRITON. G. H. Derrick (Univ. of Sydney). Nuclear Phys. 16, 405-22(1960) May (2). (In English)

The matrix elements of the kinetic energy operator and of the common potential energy operators are calculated for the total angular momentum and isobaric spin functions of the triton. The conditions necessary for the convergence of the kinetic energy integrals are investigated. (auth)

18369

METHOD FOR SEPARATING THE RELATIVE MOTION OF TWO NUCLEONS IN OSCILLATOR POTENTIAL WELL. V. V. Blashov and V. A. Eltekov (Moscow Univ.). Nuclear Phys. 16, 423-31(1960) May (2). (In English)

Invariant coefficients independent of magnetic quantum numbers are introduced for separating the relative motion of two nucleons in an oscillator potential well ("generalized Talmi coefficients"). Tables of these coefficients are given for the first oscillator states including 3p and 3f shells. (auth)

18370

μ-HYDROGEN MOLECULAR ION AND COLLISIONS BETWEEN μ-HYDROGEN ATOM AND PROTON, DEUTERON AND H ATOM. Ta-You Wu, R. L. Rosenberg, and H. Sandstrom (National Research Council, Ottawa). Nuclear Phys. 16, 432-59(1960) May (2). (In English)

To the order μ/M, the ratio of meson and proton masses, the following quantities are calculated: (1) the energy of the ground state of the molecular ion $(p-\mu-p)^+$; (2) the square of the meson wave function at the position of a proton in $(p-\mu-p)^+$, (3) the "vibrational" level of $(p-\mu-p)^+$. The theory of direct and exchange collisions $(p-\mu) + d \rightarrow (p-\mu) + d$, $(p-\mu) + d \rightarrow (d-\mu) + p$ is given in terms of the coupling between the meson and nucleon motions. These cross-sections and that of the elastic scattering $(p-\mu) + p$ are calculated for energies corresponding to the temperature of liquid hydrogen. The cross-section of the $(p-\mu-p)^+$ formation process $(p-\mu) + H \rightarrow (p-\mu-p)^+ + e$ is calculated, leading to a value $\approx 1/18$ for the relative chance of a μ-meson being found in the atomic $(p-\mu)$ system and in the molecular system $(p-\mu-p)^+$ in liquid hydrogen. This, together with (2), leads to the relative probability of ≈ 6.3 of a μ-meson being captured by a proton in the molecular and the atomic state, if μ-capture in the hyperfine state F = 0 only (corresponding to an interaction V–A for the capture process) is assumed. (auth)

18371

APPLICATION OF DISPERSION RELATIONS FOR TESTING QUANTUM ELECTRODYNAMICS AT SMALL DIS-

TANCES. P. S. Isaev and I. S. Zlatev (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys. 16, 608-18 (1960) June (1). (In English)

Corrections to the Bethe-Heitler bremsstrahlung formula in the lowest approximation in e are calculated using the method of dispersion relations. The problem of the limit of applicability of quantum electrodynamics at small distances is considered. (auth)

18372

ON THE COUPLING OF A $j = 3/2$ PARTICLE TO NUCLEAR QUADRUPOLE SURFACE OSCILLATIONS. B. F. Bayman and L. Silverberg (Univ. of Copenhagen and Nordisk Institut for Thoretisk Atomfysik, Copenhagen). Nuclear Phys. 16, 625-44(1960) June (1). (In English)

An intermediate coupling calculation is performed for a nucleon confined to move in a $j = 3/2$ orbit and coupled to a nuclear surface capable of performing quadrupole oscillations. It is shown that each term in the hamiltonian commutes with a symplectic group of transformations. This feature is used to define a representation in which the hamiltonian matrix takes an especially simple form. It is possible to follow the transition from weak to strong coupling, at which there appear sets of rotational bands built on equidistant vibrational excitations. These rotational bands have some special features due to the γ-instability of the problem. (auth)

18373

COLLISION OF NUCLEONS WITH LARGE ANGULAR MOMENTA. A. D. Galanin, A. F. Grashin, B. L. Ioffe, and I. Ya. Pomeranchuk (Inst. of Theoretical and Experimental Physics, Moscow). Nuclear Phys. 17, 181-217(1960) June (3). (In English)

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18374

ON PERIPHERAL NUCLEON–NUCLEON INTERACTION IN THE TWO-MESON APPROXIMATION. A. F. Grashin and I. Yu. Kobsarev (Inst. of Theoretical and Experimental Physics, Academy of Sciences, Moscow). Nuclear Phys. 17, 218-26(1960) June (3). (In English)

Triplet nucleon-nucleon scattering phase shifts for nonrelativistic energies are calculated in the two-meson approximation and compared with the one-meson phase shifts. The one-meson approximation is found to be accurate for all mixing parameters (beginning from $^3S-^3D$) and this permits one to use them in phase shifts analysis for selection of unique solution. The peripheral part of the effective two-meson potential corresponding to the derived scattering amplitude is also given. (auth)

18375

ON THE INTERACTION HAMILTONIAN FOR THE DECAY OF Σ-HYPERONS. Shoichi Hori (Instituttet for Teoretisk Fysik, Copenhagen). Nuclear Phys. 17, 227-37(1960) June (3). (In English)

The interaction hamiltonian for the decay of Σ-hyperons is phenomenologically constructed under the assumptions that: (1) the spin of the Σ-hyperon is $1/2$, (2) the CP-invariance holds, (3) the effects of the final state interactions are negligible, (4) $\tau(\Sigma_-) = 2\tau(\Sigma_+)$, (5) the branching ratio $w(\Sigma_+ \rightarrow p + \pi_0)/w(\Sigma_+ \rightarrow n + \pi_+) = 1$, (6) the $\Delta I = 1/2$ rule is valid, and (7) $\alpha_+ = \alpha_- = 0$. These assumptions are sufficient to determine the interaction hamiltonian uniquely if the coupling type (derivative or direct) of the hamiltonian is prescribed, and from the hamiltonian the result $\alpha_0 = \pm 1$ is obtained, not inconsistent with the experiment. Conversely, when the assumption (6) is replaced by $\alpha_0 = \pm 1$, it cannot be concluded that the $\Delta I = 1/2$ rule holds. If $\alpha_0 = \pm 1$, $\alpha_+ = 0$, and an arbitrary α_- are assumed, taking into account the fact that the polarization of the Σ_--hyperon may be small, two kinds of solutions are obtained, one of which coincides with the result under the assumption $\alpha_- = 0$; the other yields $|\alpha_-| = 0.8$. (auth)

18376

ANNIHILATION OF POLARIZED POSITONS IN MAGNETIZED MATERIAL. I. Lovas (Central Research Inst. for Physics, Budapest). Nuclear Phys. 17, 279-88(1960) June (3). (In English)

The dependence of angular correlation of positron annihilation radiation on the polarization of negatrons and positrons was analyzed and measured. The contribution of the bound negatrons to the annihilation process is about 5%. (auth)

18377

INTERPRETATION OF ELECTRODYNAMICS AND BARYON THEORY WITHIN A SIX-DIMENSIONAL MANIFOLD. Jerzy Rayski (Jagellonian Univ., Krakow and Physical Inst., Polish Academy of Science, Krakow). Nuclear Phys. 17, 289-316(1960) June (3). (In English)

Assuming a six-dimensional world with a singular metric, a unitary theory of gravitation and electromagnetic field is formulated. Electric charge is interpreted as angular momentum in the fifth and sixth dimensions. Sommerfeld's constant is closely connected with the degree of singularity of the metric tensor. Isobaric spin and its connection with the electric charge as well as the pseudoscalar character of pions are easily interpretable. The hypothesis of a six-dimensional world enables a systematization of elementary particles. In particular, it is shown that the baryon family fits quite naturally into the six-dimensional framework. (auth)

18378

MILNE'S PROBLEM FOR A VELOCITY-DEPENDENT MEAN FREE PATH. Mark Nelkin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng. 7, 552-3(1960) June.

The problem of the extrapolation distance for an energy-dependent mean free path was studied. A variational solution for constant cross section, which gave the extrapolation distance very accurately using the solution far from the boundary as a trial function, was extended to cover the multivelocity problem appropriate for varying mean free path. The value obtained by this method was 0.3% smaller than the exact value. (M.C.G.)

18379

RESONANT ELECTRON CAPTURE AND STRIPPING IN MODERATELY LARGE-ANGLE ATOMIC COLLISIONS. F. P. Ziemba, G. J. Lockwood, G. H. Morgan, and E. Everhart (Univ. of Connecticut, Storrs). Phys. Rev. 118, 1552-61(1960) June 15.

Differential scattering of ions by atoms in the energy range of 1 to 200 kev was studied. The incident ion, after a single collision which is hard enough to result in a 5° deflection, was analyzed to determine whether it had captured or lost electrons. The angle 5° was chosen as a typical moderately large angle and held fixed as the energy of the incident ion was varied. When the electron capture probability is plotted vs energy, one or more peaks are observed. For the symmetrical case of He^+ on He, seven peaks are clearly outlined. Four peaks appear in the H^+ on He combination and three with H^+ on H_2. Single or double peaks are found in other

cases studied which include H^+ on N_2, O_2, air, Ne, Ar, and Kr; H_2^+ on H_2 and He; H_3^+ on H_2 and He; H^+ on H_2 Ne, Ar, and Kr; N^+ on Ar; N_2^+ on N_2; Ne^+ on Ne and Ar; N^{++} on Ne and Ar; Ar^+ on Ar; and Kr^+ on Kr. For each case the probabilities for electron capture, scattering without change of charge, and various degrees of electron stripping are plotted vs energy. In those cases in which the electron capture probability curve has more than two peaks, these peaks are nearly evenly spaced when the probabilities are plotted vs the time of the interaction. This indicates an electron exchange effect whose period is of the order of 10^{-16} second. In cases where there are many electrons involved in the colliding atoms the phenomenon is more complicated, but vestiges of this resonant exchange are sometimes observed. (auth)

18380

PARITY NONCONSERVING INTERNUCLEON POTENTIALS. R. J. Blin-Stoyle (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 118, 1605-7(1960) June 15.

The general form that a parity nonconserving internucleon potential must take because of invariance requirements is obtained. A detailed calculation is then made of the parity nonconserving potential arising from a self-interacting current description of weak interactions. If the polar vector part of the current (J_μ^V) is conserved, then parity nonconservation of the order 1 part in 10^7 ($\mathcal{F} \approx 10^{-7}$) is to be expected in nuclear processes. Failure to observe such an effect would indicate either that J_μ^V is not conserved or that the self-interacting current description is incorrect. (auth)

18381

π-NUCLEON PHASE SHIFTS IN THE ENERGY RANGE 350 to 600 Mev. W. D. Walker, J. Davis, and W. D. Shephard (Univ. of Wisconsin, Madison). Phys. Rev. 118, 1612-14(1960) June 15.

The results of attempts to obtain a set of phase shifts valid in the energy region just above the 3-3 resonance are presented. It is possible to extend the family of phase shifts found by the workers at Dubna at an energy of about 300 Mev. The features of this set of phase shifts are that α_1, α_{11}, are positive and α_{13} is negative and small. In addition it was found that δ_{13} is positive and δ_{15} negative. At 600 Mev the results are probably consistent with a resonance in the $d_{3/2}$ state, but do not conclusively indicate such a resonance. This resonant state, however, decays a sizable fraction of the time into a final state with two π mesons. There are indications that at energies of 400 to 500 Mev that most of the single pion production comes from s and $p_{1/2}$ states. (auth)

18382

FORMAL PARADOX IN QUANTUM ELECTRODYNAMICS. Herbert M. Fried (Univ. of California, Los Angeles). Phys. Rev. 118, 1642-5(1960) June 15.

The formal paradox concerning the vanishing of the photon self-mass, obtained by a formal manipulation, is examined in Källén's formulation of electrodynamics. It is suggested that this difficulty can be removed, and the formal manipulation retained, by a regularization of the Heisenberg operators. An alternate method of obtaining the spectral function of the photon commutator is described, and a possible consequence of regularization, in connection with the proof of the renormalization constants' divergence, is briefly discussed. (auth)

18383

MOMENT OF INERTIA OF SUPERFLUID MANY-FERMION SYSTEMS. Ronald M. Rockmore (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 118, 1645-52 (1960) June 15.

The effects of possible superfluidity on the cranking moment of a large many-fermion system moving under periodic boundary conditions were investigated within the framework of the theory of superconductivity recently formulated by Bogolyubov. The Hamiltonian was initially subjected to Bogolyubov's general unitary transformation. The collective excitations of the fermions were then considered in the usual pair approximation; the appropriate cranking terms were linear in the boson pair operators. On performing a unitary transformation which transformed away these linear terms, an expression was obtained for the moment of inertia of the system which included both the effects of possible superfluidity and collective excitation. This expression, by virtue of its being stationary with respect to arbitrary variations in the amplitude associated with the latter unitary transformation, was then utilized as a variational principle for the moment of inertia. The result previously obtained that the moment of inertia had a rigid value, was rederived in more compact form. For the superfluid state, it was found that collective excitations effected a marked increase in the superfluid moment at intermediate coupling strengths although the resulting moment was still quite small compared to the rigid value. In contrast to the normal state case, where particle-hole pairs play a major role, this increase was almost entirely due to excitations consisting of particle-pairs or hole-pairs. The precise magnitude of the apparent resonance in the moment produced by the d-wave part of the cranking interaction was dependent to some extent on the features of the particle-particle potential which led to the superfluid state. Variational expressions for the moment were exhibited for both Yukawa and delta-function shell potentials. These results were identical in charged and neutral Fermi systems. A calculation of the cranking moment at finite temperatures was presented in an Appendix along with an interpretation of it in terms of Bardeen's two-fluid model of superconductivity. (auth)

18384

FOLDY TRANSFORMATION IN THE PION–HYPERON SYSTEM. Akira Kanazawa (Purdue Univ., Lafayette, Ind.). Phys. Rev. 118, 1664-6(1960) June 15.

A unitary transformation, which played the same role as the Foldy transformation in the pion-nucleon system, was constructed for the case where the pion interacts with both Σ and Λ hyperons through γ_5 couplings. The transformation function and the transformed Hamiltonian were very similar to those of the Foldy transformation, in spite of the complexity of the system in isotopic spin space. The application to practical problems was not considered in this paper. (auth)

18385

RECENT INVESTIGATIONS OF HIGH ENERGY PARTICLES. L. D. Puzikov. Priroda 49, No. 3, 85-7(1960) Mar. (In Russian)

Data are presented from studies made of particles with high energies. Scattering of nucleons on nucleons, hypothesis of charge independence, discovery of the "super strange" elementary particle with mass 1450 m_e, and analysis of λ^0 are discussed. (R.V.J.)

18386

THE DISCOVERY OF THE ANTIPROTON. V. I. Goldanskii. Priroda 49, No. 4, 49-55(1960) Apr. (In Russian)

A review is given of the history of the search, discovery, and research studies of antiprotons. The discovery of anti-

protons gave an impetus to finding other negatively charged particles and the Σ^- hyperon with mass 2342 and life-time 1.7×10^{-10} sec (with positive charge and decay into anti-neutron and π^+ meson). (R.V.J.)

18387

ON LEVINSON'S THEOREM IN THE THEORY OF MULTI-CHANNEL SCATTERING. Gaku Konisi and Takesi Ogimoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto) 22, 807-13 (1959) Dec. (In English)

Using a Lee-type model, Levinson's theorem was investigated in the case of multi-channel scatterings. In this case, contrary to the case of potential scatterings or Dyson's model, it seems that Levinson's theorem becomes ambiguous in interpreting the physical meaning of the result obtained. (auth)

18388

ON THE POSSIBILITY OF THE TWO-FERMION INTERACTION. Haruo Obayashi (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto) 22, 835-42(1959) Dec. (In English)

As the general source for non-leptonic weak interactions, an elementary two-fermion interaction is introduced and investigated. The calculated asymmetry factors and decay rates for Λ and Σ decays show that this interaction, with some corrections due to the strong pion-baryon interactions, does not seem sufficient to describe these decay processes. Hence the main features of weak interactions cannot be ascribed to the two-fermion interaction only. (auth)

18389

REMARKS ON THE TRANSFORMATION PROPERTIES OF THE DIRAC EQUATION. Pong Y. Pac (Kyoto Univ.). Progr. Theoret Phys. (Kyoto) 22, 857-62(1959) Dec. (In English)

The physical properties of dynamical variables in the extreme-relativistic representation are discussed. It is pointed out that the choice of the proper mean position must be careful, and that the results include those of Bose-Gamba-Sudarshan as special cases. (auth)

18390

ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. III. STATIC LIMITS AND S-WAVE EFFECTS. Kichiro Hiida and Noboru Nakanishi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 22, 863-81(1959) Dec. (In English)

The static limits of the 3π-state contribution (lowest order) to the electromagnetic structure of the nucleon are calculated. By comparing these with Bosco and Alfaro's results, the S-wave effect on the isoscalar part is investigated in detail, and it is shown that the S-wave effect is quite small (always less than 20%). Numerical evaluations of $\lim(r^2)^S_{1,2}$, etc., also are carried out, but the numerical values are too sensitive to cut-off to draw any quantitative conclusion. (auth)

18391

INCONSISTENCY AMONG THE PROPERTIES OF RENORMALIZABILITY, ANALYTICITY, AND REGULARITY AT ZERO CHARGE. Steven C. Frautschi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 22, 882-8(1959) Dec. (In English)

The photon propagator is analyzed by means of general properties of the present theory of electrons and photons. It can be shown, by consideration of the charge renormalization group, that the photon propagator is independent of physical charge in the high energy limit. If, in addition to renormalizability, regularity at vanishing physical charge is assumed, then the bare charge vanishes. On the other hand, the commonly assumed analyticity properties require that bare charge exceeds physical charge. Thus at least one of the general properties assumed is inadmissible. This relationship of expressions satisfying the charge renormalization group equations to analyticity properties and definite sets of Feynman diagrams (which correspond to an expansion about zero charge) is illustrated by a simple example. (auth)

18392

NOTE ON THE FORBIDDEN PROCESSES OF THE LEPTONIC DECAYS. Toshimi Adachi and Shinzo Nakai (Tokyo Metropolitan Univ., Tokyo). Progr. Theoret Phys. (Kyoto) 22, 889-90(1959) Dec. (In English)

An attempt to forbid unwanted leptonic decay processes is made on the assumption that the Fermi interactions are invariant under the strong reflection. Strong reflection parities are assigned to individual fermions on the basis of β decay, μ decay, and μ capture. The unwanted processes, $\mu^\pm \to e^\pm + e^\pm + e^\mp$ and $\mu^- + p \to p + e^-$, are shown to be forbidden by treating e^-, μ^-, ν, ν', and nucleons as normal particles and giving different strong reflection parities to e^- and μ^-. (D.L.C.)

18393

ON THE ONE-BODY PROPAGATOR. Keiji Watanabe (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 22, 895-7 (1959) Dec. (In English)

The vanishing of the renormalized charge used so successfully in quantum electrodynamics is due to the singularity of the propagator being not less than that of the free field near the light cone. The connection between the canonical formalism and the singularity of the one-body propagator is derived, being restricted to the interaction of the spinor and boson fields, and it is shown that no hamiltonian exists for this interaction. It is concluded that an interaction for which there is no hamiltonian is needed to smooth out the renormalization theory. The possibility of weakening the propagator singularity by the gravitational field is discussed. (D.L.C.)

18394

ON A POSSIBLE SMALL PAULI TERM IN QUANTUM ELECTRODYNAMICS. Ko Aizu and Tsuyoshi Honda (Rikkyo Univ., Tokyo). Progr. Theoret Phys. (Kyoto) 22, 897-9(1959) Dec. (In English)

The substitution of a nonlocal interaction and a cutoff procedure for the local electron–photon interaction in the calculation of the electron mass in the low-energy limit introduces a small Pauli term, δ. The δ is calculated, first by using the precise anomalous magnetic moment of the electron, giving $\delta = 7.4 \pm 5 \times 10^{-6}$, and then by using the Lamb shift in the H atom, giving $\delta = -1.7 \pm 3.4 \times 10^{-6}$. Calculation using the fine structure of positronium was also performed, resulting in $\delta = 2.5 \pm 9.8 \times 10^{-6}$. It is concluded that there is no definite evidence for or against the existence of a Pauli term. The possible role of the Pauli term in quantum electrodynamical processes is discussed; it is similar to the modification in quantum electrodynamics at small distances. (D.L.C.)

18395

A NOTE ON THE SIGNS OF THE $K^\pm$–p INTERACTIONS. Yukihisa Nogami (Univ. of Osaka Prefecture Sakai, Japan). Progr. Theoret. Phys. (Kyoto) 22, 899-901(1959) Dec. (In English)

The signs of the $K^\pm$-p interactions are studied using the Yukawa interaction hamiltonian and varying the type of the ($N\Lambda K$) and ($N\Sigma K$) couplings from scalar to pseudoscalar in the Born approximation. The question of whether or not the signs are changed by higher order effects is explored

with emphasis on the 4th order perturbation pion correction. The results for scalar couplings give repulsion for K^--p and attraction for K^+-p, and it is concluded that models with scalar couplings give wrong signs for both interactions. For pseudoscalar couplings, the Born term in the Low equation is replaced by an effective scattering interaction, and the pion correction is shown to be small for K^+-p but fairly large and attractive for K^--p, which is as expected. (D.L.C.)

18396

S-WAVE INTERACTION IN π-N SYSTEM AND DISPERSION RELATION. Shigeo Minami (Osaka City Univ.). Progr. Theoret Phys. (Kyoto) 22, 901-3(1959) Dec. (In English)

Dispersion relations applied to pion reactions have explained the value of $\alpha_1-\alpha_3$ (α_1, α_3 = s-wave phase shifts for isotopic spin states $I = \frac{1}{2}, \frac{3}{2}$), but the separate value of α_1 or α_3 has not yet been explained. This is done by setting $G_r(O, \mu, M, f^2) = G_r(O,O, M, f^2)$, where $G_r(k, \mu, M, f^2)$ is the physical equivalent of $G(k, \mu, M, f^2)$ in the dispersion relation for π-p forward scattering amplitudes, $\frac{1}{2}[D_-(\omega) + D_+(\omega)]$. The results, used in combination with the value of 0.27 for $\alpha_1-\alpha_3$, give $\alpha_1 = 0.16$ and $\alpha_3 = -0.11$, in good agreement with experimental data analysis for low-energy pion scattering. (D.L.C.)

18397

TWO-NUCLEON PROBLEM AND DISPERSION RELATION IN NUCLEON–NUCLEON SCATTERING. Yasuo Hara (Tokyo Univ.). Progr. Theoret Phys. (Kyoto) 22, 905-7(1959) Dec. (In English)

A mathematical treatment for nucleon–nucleon interactions is presented in which dispersion relations with a unitary condition are used instead of the ordinary Schrödinger equations for the meson theoretical potential. The integral over the unphysical region is calculated exactly with the aid of Feynman diagrams. The s-wave behavior at low energies and the d-state mixings of α-waves and of the deuteron are computed. (D.L.C.)

18398

AN INTERPRETATION OF THE PEAK IN THE CROSS SECTION OF $\pi^- + p \rightarrow K^0 + \Lambda$. Yukihisa Nogami (Univ. of Osaka Prefecture, Sakai, Japan) and Reiji Sugano (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 22, 907-9(1959) Dec. (In English)

The peak in the cross section of $\pi^- + p \rightarrow K^0 + \Lambda$ at a pion bombarding energy slightly below 1 Bev is studied with a model based on the fact that the total $I = \frac{1}{2}$ π-p cross section has a peak close to that of the Λ production cross section. The equations for the Λ production cross section are derived both as a function of energy and for resonance energy, and the former, plotted on an energy graph, is consistent with experimental data. It was assumed that the compound state is formed by the incident pion plus the nucleon core, and the implications of such an assumption are discussed. (D.L.C.)

18399

QUANTUM MECHANICS IN CURVED SPACE-TIME. S. P. Misra (Utkal Univ., Cuttack, India). Progr. Theoret. Phys. (Kyoto) 23, 1-16(1960) Jan. (In English)

A set of equations for elementary particles when the space is curved is obtained by substituting the curved space metric for the flat space one in the matrices which describe these particles. For the Dirac or Duffin-Kemmer matrices, the same set of equations are obtained if the flat space equations are assumed to be true in the local frame of reference at any point. The approximate corrections to the different fields when the curvature is small were obtained. This procedure gives a redefinition of the affine relationship. It is assumed throughout that the curvature is introduced in the space-time world due to the presence of matter by the relationship of general relativity. (auth)

18400

ON A POSSIBLE GENERALIZATION OF QUANTUM MECHANICS. Tadashi Kaneno (Kwansei Gakuin Univ., Nihinomiya, Japan). Progr. Theoret. Phys. (Kyoto) 23, 17-31(1960) Jan. (In English)

An attempt is made to enlarge the number field underlying quantum mechanics from complex to quaternion. It is not impossible to construct quaternion quantum mechanics in quite a similar manner to the usual complex quantum mechanics, though some limitations are necessary for the position of factors. As a special case, the charge properties of the spin-0 particles are considered. This example may show some new way to generalize the concept of the charge of the elementary particles without adoption of the iso-space. (auth)

18401

A FORMAL THEORY OF COLLECTIVE BEHAVIOR. Kazuo Hiroike (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto) 23, 41-60(1960) Jan. (In English)

The method of auxiliary variables is generalized so as to be applicable to the systems having strong interparticle interactions or obeying Fermi-Dirac statistics. The ground state energy and the excitation energy spectrum are calculated to the zeroth approximation. It is shown that Feynman's relation for liquid helium and Tomonaga's expression for a one-dimensional Fermi gas can be derived as the special cases of the present theory. The theory is applied also to the classical statistical mechanics. (auth)

18402

DEPENDENCE OF p-p SCATTERING PARAMETERS ON PHASE SHIFTS. B. P. Nigam (Univ. of Rochester, N. Y.). Progr. Theoret. Phys. (Kyoto) 23, 61-75(1960) Jan. (In English)

An attempt is made to deduce the dependence of the double and triple p-p scattering parameters on the $^1S_0$, $^1D_2$, $^3P_{0,1,2}$, $^3F_2$ phase shifts with special reference to the SM1 potential at 150 Mev. It is found that a positive depolarization requires a small or even negative $^3P_0$ phase shift, thus favoring a strong spin-orbit potential. The parameters R and A depend chiefly on the $^1S_0$ and $^1D_2$ phase shifts. (auth)

18403

ON THE DERIVATION OF THE OPTICAL POTENTIAL IN INFINITE NUCLEAR MATTER. B. Jancovici (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 76-80(1960) Jan. (In English)

The optical potential for a nucleon in infinite nuclear matter is derived, all nucleons and interactions being symmetrically treated. The exchange effects are exhibited; a previously neglected exchange interaction, which has an important effect for the real part at low energy, is discussed and numerically computed. (auth)

18404

BREMSSTRAHLUNG IN HIGH DENSITY MEDIA AT HIGH ENERGIES. Yoshi H. Ichikawa (Nihon Univ., Tokyo) and Masaaki Yamamoto (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto) 23, 81-6(1960) Jan. (In English)

Qualitative discussions are presented concerning the effects of the collective motion of media for the bremsstrahlung process in high density at high energies. The derived formula of the bremsstrahlung cross section is similar to the Nozieres-Pines' cross section of Compton scattering obtained by taking into account effects of the collective motion of electrons. (auth)

18405

A FIELD THEORETICAL INVESTIGATION OF MULTIPLE MESON PRODUCTION. I. PION-NUCLEON COLLISIONS. Keizo Kobayakawa (Nara Medical Coll., Kashihara, Japan) and Tsutomu Imamura (Univ. of North Carolina, Chapel Hill). Progr. Theoret. Phys. (Kyoto) 23, 137-60(1960) Jan. (In English)

Multiple meson production in pion-nucleon collisions is investigated by field theory. By introducing the interaction time and assuming that the free hamiltonian can be approximately put as a C-number during the calculation of the effect due to the interaction hamiltonian for the interaction time-interval, it is shown that multiple meson production is caused by the pseudoscalar type interaction. Numerical results are obtained for the relative cross sections of n pion production, the angular distribution, the momentum distribution of final nucleons, etc. These results are compared with the experimental data in Bev and cosmic ray energy regions. The covariant phase space integration is carried out with the saddle point method and its final expression is comparatively simple. The probability distribution of charge states in the statistical theory is derived by an approximate formula instead of the tedious combination of Clebsh-Gordan coefficients. (auth)

18406

POSSIBILITY FOR OR AGAINST THE EXISTENCE OF A NEUTRAL SCALAR MESON. Keiji Igi (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 170-2(1960) Jan. (In English)

The possible existence of a pole term for a neutral heavy scalar meson is explored using extrapolation analysis of π^--p scattering and assuming that the mass of the new meson is intermediate between that of the π meson and twice that value. The results indicate that the pole contribution is not zero but that the new meson, if it exists, plays only a minor role in the world of strong interactions. (D.L.C.)

18407

POLARIZATION OF PROTON SCATTERED FROM Li^6, Be^9 AND B^{11}. Yoshiyuki Sakamoto and Toshinori Takemiya (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 172-5 (1960) Jan. (In English)

Expressions for the polarization of protons elastically scattered by Be^9, B^{11}, and Li^6 are derived using spin wave functions and are composed of two terms, that for the spin flip and that for the non-spin flip of target nucleons. Since the non-spin flip is dominant in the polarization, the results for Be^9, B^{11}, and Li^6 are very similar. Graphs are presented with experimental and theoretical curves for 180-Mev protons. (D.L.C.)

18408

THE NEW VIEWPOINT OF THE HIGH ENERGY ELASTIC SCATTERING OF NUCLEONS FROM NUCLEI. Tatuya Sasakawa (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 177-80(1960) Jan. (In English)

If high-energy elastic scattering of nucleons is calculated for heavy nuclei using direct two-body collisions (impulse approximation) and ignoring the multiple scattering effect, the results are larger than the experimental values, although they reproduce the shape fairly well. On the other hand, the main terms of multiple scattering can be put in the form of a reduction factor which is expected to be constant for heavy nuclei. The reduction factor is derived and the resulting cross sections are plotted for 95-Mev proton scattering by C, Cu, Al, and Pb together with the experimental and impulse approximation curves. (D.L.C.)

18409

GROUND STATE OF A SYSTEM CONSISTING OF TWO OPPOSITELY CHARGED PARTICLES IN COULOMB FIELD. Mitio Inokuti, Kanji Katsuura, and Hiroshi Mimura (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 186-7(1960) Jan. (In English)

The problem of whether or not two oppositely charged particles can form a bound state in the Coulomb field is considered, and it is found that the mass ratio of the heavier particle to the other must be more than 7.8 in order to give such a bound state. The InSb crystal is concluded to be capable of forming a bound state of an exciton at a positively charged imperfection since the mass ratio in such a case is ca. 15. (D.L.C.)

18410

ELECTRIC MULTIPLE TRANSITIONS IN THE D(γp)n REACTION AT HIGH ENERGY. Masahiko Matsumoto (Shiga Univ., Otsu, Japan). Progr. Theoret. Phys. (Kyoto) 23, 188-90(1960) Jan. (In English)

The cross sections for the D(γ,p)n reaction were calculated in the energy range 80 to 300 Mev using the full electric interaction expression and approximating the final state wave function with a plane wave. The results are plotted vs. θ at 80 Mev together with the curves obtained from using the first term only of the electric interaction expression for the E1 and E2 transitions, and it is concluded that the latter approximation is not justified in the high energy region (>80 Mev). The excitation functions are also plotted from the above calculations, and it is seen that the exact calculations agree well with the observed values except in the hump region. (D.L.C.)

18411

A NOTE ON THE POLARIZATIONS FOR p-He^3 AND p-T^3 SCATTERING. Yoshiyuki Sakamoto and Toshinori Takemiya (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 190-2(1960) Jan. (In English)

Polarization equations are derived for proton elastic scattering by He^3 and T, where the spin flip terms are more important than the non-spin flip terms. The impulse approximation was used and the D-states neglected. The polarization for He^3 is found to be larger than that for T; this is ascribed to the neutron pairing in T. (D.L.C.)

18412

ON THE CHARGE DISTRIBUTION OF THE PROTON. Kichiro Hiida, Noboru Nakanishi, and Takanori Shiozaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 192-4 (1960) Jan. (In English)

Present values for the mean square radius of charge for the proton are examined with the assumptions that (1) the charge distribution of the isovector part is positive, (2) that of the isoscalar part is negative in the inner region and positive in the outer region, and (3) the a.m.m. distribution of the proton is positive. Curves of F_1 vs. F_2 which might be expected are given. (D.L.C.)

18413

PROTON-ANTIPROTON ANNIHILATION AND NUCLEON STRUCTURE. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto) 23, 194-6(1960) Jan. (In English)

The multiplicity of pions in proton-antiproton annihilations is estimated with certain assumptions for three models of proton charge distribution: exponential, zero cutoff, and finite cutoff. The results agree well with the observed value of 4.7 ± 0.4. The above assumptions are examined on the basis of other observed pion phenomena, notably π-N scattering. (D.L.C.)

18414
MEASUREMENT OF ENERGY LOSSES OF 70 kev ELECTRONS BY AN ELECTROSTATIC ANALYZER IN GASES. A. N. Kabanov, Yu. M. Kushnir, and L. M. Krutyakova. Radiotekh. i Elektron. 5, 981-5(1960) June. (In Russian)

An electrostatic electron rate analyzer with resolving power of 150,000 : 1 was used for determining the energy losses of 70-kev electrons after interaction with atomic and molecular gases. (R.V.J.)

18415
DIFFUSE SCATTERING OF X-RAYS BY QUARTZ CRYSTALS BEFORE AND AFTER NEUTRON IRRADIATION. E. V. Kolontsova and L. A. Ignat'eva (Lomonosov Moscow State Univ.). Soviet Phys.-Cryst. 4, 781-5(1960) June.

A comparison was made of the intensity and form (in reciprocal lattice space) of the regions of diffuse scattering from quartz monocrystals before and after neutron irradiation. After irradiation of the crystals with 10^{17} and 10^{18} neutrons/cm^2, the diffuse scattering did not differ from the thermal scattering from a nonirradiated crystal; after irradiation with 10^{19} neutrons/cm^2 the form of the scattering maxima was unchanged, but their intensity was increased about one-and-a-half times. (auth)

18416
COMPARISON OF THE PHOTOPRODUCTION OF π^0 ON PROTONS WITH THE PREDICTION ACCORDING TO THE DISPERSION THEORY. K. Dietz, G. Höhler, and A. Müllensiefen (Universität, Munich). Z. Physik 159, 77-88 (1960). (In German)

The real parts of the photoamplitudes $E_1 S_{1/2}$, $M_1 P_{1/2}$, and $M_1 P_{3/2}$ were calculated from the angular distribution of the reaction $\gamma + p \rightarrow p + \pi^0$ measured by Goldansky et al. at 160 to 240 Mev. One of the solutions agreed with the theoretical prediction for the $M_1 P_{3/2}$ amplitude according to the dispersion method of Chew, Goldberger, Low, and Nambu. There was a discrepancy for $M_1 P_{1/2}$ if α_{11} was taken from the effective range formula, but the positive values of α_{11}, necessary to give agreement, were not excluded by the results of the phase shift analysis, especially since Pontecorvo et al. recently found positive values at higher energies. The prediction for the real part of the $E_1 S_{1/2}$ amplitude agreed with the experimental data, if large recoil corrections were added which had been neglected by Chew et al. (auth)

18417
THE ENERGY DISTRIBUTION OF MODERATELY FAST ELECTRONS ON PASSAGE THROUGH THIN LAYERS. G. Syrbe (Deutsche Akademie der Wissenschaften, Berlin). Z. Physik 159, 237-42(1960). (In German)

A partial differential equation was developed for the energy distribution of moderately fast electrons upon passage through thin layers. Calculation, by a method of approximation, of the dependence of permeability on the original energy of the electron yielded the energy-range relation. Measurements on aluminum and aluminum oxide agreed with this result. (M.C.G.)

Nuclear Properties and Reactions

18418 ANL-6122(p.33-50)
Los Alamos Scientific Lab., N. Mex.
THE STATUS OF MEASUREMENTS OF $\bar{\nu}$ AND $\sigma(n,\gamma)$ FOR FAST NEUTRONS. James Terrell. p.33-50 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The measurement of $\bar{\nu}$ and $\sigma(n,\gamma)$ for fast neutrons by a liquid scintillator is discussed. Previously published data on $\bar{\nu}$ and $\sigma(n,\gamma)$ for various elements are presented and compared. (C.J.G.)

18419 ANL-6122(p.51-63)
Los Alamos Scientific Lab., N. Mex.
FAST-NEUTRON SCATTERING BY U^{235}, Pu^{239}, AND U^{238}. Lawrence Cranberg. p.51-63 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Cross sections for fast neutron scattering by U^{235}, Pu^{239}, and U^{238} at 550, 1000, and 2000 kev are presented. (C.J.G.)

18420 ANL-6122(p.67-76)
Argonne National Lab., Ill.
ON THE ESTIMATION OF FAST NEUTRON CROSS SECTIONS. Peter A. Moldauer. p.67-76 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The problem of estimating inelastic fast neutron cross sections for neutron energies between a few hundred ev and several Mev and target nuclei which are not too light and not too magic is discussed. Previously published data on resonance parameters such as average level densities, width averages and fluctuations, and level spacings are reviewed. (C.J.G.)

18421 ANL-6122(p.163-76)
Oak Ridge National Lab., Tenn.
THE FAST MULTIPLICATION EFFECT DUE TO THE (n,2n) REACTION IN BERYLLIUM AND BERYLLIUM OXIDES. Wolf Häfele. p.163-76 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Upper and lower limits were established for the fast multiplication effect in Be and BeO due to the (n,2n) reaction. Nonisotropic scattering was taken into account. (C.J.G.)

18422 ANL-6122(p.209-26)
Columbia Univ., New York
REVIEW OF THE LOW ENERGY CROSS SECTIONS AND FISSION PARAMETERS OF U^{235}. George J. Safford. p.209-26 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Previously published data on cross sections and fission parameters of U^{235} at 0.0253 ev are reviewed. The experimental techniques employed in determining the data are discussed. (C.J.G.)

18423 ANL-6122(p.227-37)
General Electric Co. Hanford [Atomic Products] Operation, Richland, Wash.
STATUS OF THE LOW-ENERGY CROSS SECTIONS OF PLUTONIUM. B. R. Leonard, Jr. p.227-37 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Low-energy cross section data on Pu^{239}, Pu^{240}, and Pu^{241} are reviewed. (C.J.G.)

18424 ANL-6122(p.238-52)
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
EVALUATION OF LOW-ENERGY CROSS-SECTION DATA FOR U^{233}. J. E. Evans and R. G. Fluharty. p.238-52 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959. (IDO-16554).

Methods of evaluating low-energy cross section data for fissile nuclei are discussed. The U^{233} cross sections as a function of energy in the Maxwellian region and the determination of U^{233} cross section 2200 m/sec values are discussed. Previously published data on η, ν, and α of U^{233}

for a Maxwellian distribution are compared and evaluated. (C.J.G.)

18425 ANL-6122(p.253-71)
Oak Ridge National Lab., Tenn.
A REPORT ON THE MEASUREMENTS OF ETA OF U^{233} AT ORNL. G. deSaussure. p.253-71 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Previously determined values of η of U^{233} are compared. The experimental techniques for determining the values are discussed. Critical cylinder and manganese bath experiments yielded eta values of 2.297 ± 0.011 and 2.30 ± 0.2, respectively. (C.J.G.)

18426 ANL-6122(p.272-81)
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England.
RECENT BRITISH MEASUREMENTS ON NEUTRON YIELDS FROM U^{233} AND U^{235}. J. E. Sanders. p.272-81 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Measurements on η of U^{233} and U^{235} and ν of U^{235} are reviewed. The experimental methods employed in ascertaining the values are discussed. (C.J.G.)

18427 APEX-369
General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
TWO-GROUP CONSTANTS FOR REACTOR MATERIALS. Mary J. Stanley. May 1958. Decl. Nov. 4, 1959. 61p. Contracts AF33(038)-21102 and AT(11-1)-171. OTS.

In order to facilitate reactor design studies a compilation of calculated two-group constants averaged over the infinite-medium flux produced by a fission source was made for approximately 80 materials of interest to reactor engineers. A comparison with available experimental age measurements is included. (auth)

18428 BNL-607
Brookhaven National Lab., Upton, N. Y.
NEUTRON CROSS SECTION EVALUATION GROUP NEWSLETTER NO. 1, JUNE 1960. Rudolph Sher and Sophie Moore. 8p. OTS.

The discrepancy in the $Be^9(n,2n)$ cross section as measured by Fischer and Levin & Cranberg was partially resolved in the 2.6- to 4.1-Mev region by new measurements of the nonelastic neutron scattering. The cross section for differential elastic neutron scattering for Be^9 was determined at 2.6 to 6.0 Mev, together with that for $Be^9(n,\alpha)$ at 3.9 to 8.6 Mev. B^{10} was determined to be present in natural B to the extent of 19.8 ± 0.1%, and the cross sections for $B^{10}(n,\alpha)$ and natural B (absorption) were found to be 3840 ± 10 and 762 ± 3 barns, respectively. The cross sections for $B^{10}(n,\alpha)$ and $B^{10}(n,2\alpha)$ were determined in the Mev range. Cross sections are reported for $O^{16}(n,\alpha)$ at 5 to 7.34 Mev, O^{16} differential elastic neutron scattering at 3.0 and 6.0 Mev, $Ar^{36}(n,\alpha)$ at 1.3 to 5.5 Mev, and $Ar^{40}(n,\alpha)$ at 5.75 to 8.94 Mev. Neutron capture cross sections in the kev energy range are reported for Nb, Mo, Rb, Pd, Ag, Cd, In, Sn, W, Pt, and Au. Thermal neutron total cross sections at 0.02 to 0.20 ev are reported for U^{233}, U^{235}, Pu^{240}, U^{234}, and I^{129}, with the results for 0.02 to 0.04 ev being given at 2200 m/sec. Neutron multiplication data are given for U^{233} and Pu^{239}. (D.L.C.)

18429 LA-1669
Los Alamos Scientific Lab., N. Mex.
COLLECTED REPORTS ON FISSION CROSS SECTION OF U^{237} IN THERMAL NEUTRON, INTERMEDIATE NEUTRON, AND DEGRADED FISSION NEUTRON SPECTRA. G. A. Cowan, comp. Jan. 1, 1955. Decl. May 11, 1960. 66p. Contract W-7405-eng-36. OTS.

The neutron fission cross section of U^{237} was measured in a thermal neutron spectrum and in a somewhat degraded fission spectrum. The fission cross section for thermal neutrons was found to be <2 barns; the ratio of the fission cross section of U^{237} to that of U^{235} in the degraded fission spectrum was found to be 0.476 ± 15% which corresponded to $\bar{\sigma}_f$ in this spectrum equal to 0.66 ± 0.10 barns. The average neutron fission cross section of U^{237} was measured in a neutron energy range extending from approximately 100 ev to fission spectrum. The average fission cross section in this spectrum was found to be 0.70 ± 0.07 barns. The low thermal fission cross section for U^{237} (<2 barns) indicates that the excitation function for fission probably shows an effective threshold. If the excitation function is like all other heavy element ($Z \leq 90$) neutron fission excitation functions, it will exhibit a region of approximate constancy starting at a neutron energy of 0.5 to 1 Mev above its effective threshold and extending to a neutron energy in the neighborhood of 5.5 Mev. A hypothetical excitation function for neutron fission of U^{237} is suggested which has a roughly constant plateau value of 0.6 to 0.8 barns. The plateau value would be reached at <200 kev neutron energy if there is no maximum in the excitation function larger than the plateau value. The effective threshold for fission would occur at some higher energy if such a maximum exists. (auth)

18430 LA-2111
Los Alamos Scientific Lab., N. Mex.
NEUTRON EMISSION PROBABILITIES FROM THE INTERACTION OF 14-MEV NEUTRONS WITH Be, Ta, Bi, AND U^{238}. Louis Rosen and Leona Stewart. Jan. 1957. Decl. May 5, 1960. 27p. Contract W-7405-eng-36. OTS.

The spatial and spectral distributions of the neutrons from 14-Mev neutron interactions with Ta, Bi, and U were obtained using nuclear emulsion detectors in conjunction with a neutron collimator. The space-integrated neutron spectrum was obtained for Be by means of a sphere experiment. The cross sections derived from these measurements are tabulated. (auth)

18431 LAMS-2389
Los Alamos Scientific Lab., N. Mex.
COLLECTIVE OCTUPOLE VIBRATIONS OF DEFORMED NUCLEI. James J. Griffin and Lawrence Wilets. Sept. 1959. 31p. Contract W-7405-Eng-36. OTS.

Calculations are reported of the inertia and stiffness associated with octupole vibrations of nuclei in the region of 136 neutrons. The calculations are based on Nilsson's strong coupling model and include approximately the effects of residual pairing interactions. The results indicate a clear quantitative discrepancy with the observed vibrational energies. However, the calculations exhibit two enlightening qualitative features: (a) nuclei in this region are hardly stable against small octupole deformations and (b) the frequency of octupole vibrations is quite sensitive to the magnitude of the quadrupole deformation. The part of the nuclear dipole moment arising from the difference between the wave functions of the neutrons and those of protons is computed and shown to be comparable but somewhat smaller than the part due to electric polarization. The electric polarization, however, is uncertain even as to sign. (auth)

18432 TID-5929
Wisconsin. Univ., Madison.
DIFFRACTION DISINTEGRATION OF BEAM PARTICLES.

M. L. Good and W. D. Walker. [1960]. 16p. Contract AT(11-1)-64. OTS.

A phenomenon is predicted in which a high-energy particle beam undergoing diffraction scattering from a nucleus will acquire components corresponding to various products of the virtual dissociations of the incident particle, as $p \rightarrow \Lambda + K^+$ or $\pi^- \rightarrow \bar{p} + n$. These diffraction-produced systems would have a characteristic extremely narrow distribution in transverse momentum, and would have all the same quantum numbers as the initial particle; i.e., the same spin, I-spin, and parity. The process is related to that discussed in a preceding paper, and has the same effective energy threshold. (auth)

18433 UCRL-8642

California. Univ., Berkeley. Lawrence Radiation Lab. I. NUCLEAR SPECTROSCOPIC STUDIES IN THE HEAVIEST ELEMENT REGION. II. AN ACCELERATING ELECTRON SPECTROGRAPH (thesis). Royal G. Albridge, Jr. Apr. 1960. 149p. Contract W-7405-eng-48. OTS.

I. The decays of Np^{238} and Pa^{233} were studied by means of high-resolution spectroscopic instruments. The proposed decay schemes were tested by comparing the experimental data with predictions of the Bohr-Mottelson Theory of Deformed Nuclei. Previously unreported transitions were observed and some of these were used to assign new levels in the daughter nuclei, Pa^{238} and U^{233}. Gamma-gamma coincidence techniques were used to study the electron-capture decay of Cm^{241}. The decay scheme is discussed in the light of data obtained. II. An accelerating permanent-magnet electron spectrograph for the detection of low-energy electrons was constructed. The instrument can be used as either a pre- or postaccelerating spectrograph. The equipment was used to study the low-energy electron spectrum of Pa^{233}. (auth)

18434 UCRL-9130

California. Univ., Berkeley. Lawrence Radiation Lab. THE RUBIDIUM-85-RUBIDIUM-86 HYPERFINE-STRUCTURE ANOMALY (thesis). Normal Braslau. Mar. 21, 1960. 150p. Contract W-7405-eng-48. OTS.

The atomic-beam magnetic-resonance method with separated oscillatory fields was used to measure the hyperfine structure separation and magnetic dipole moment of the isotopes Rb^{85} and Rb^{86}. Observation of a $\Delta F = \pm 1$ doublet in the magnetic field region where its mean value is a minimum gives the values of these observables; the doublet separation is proportional to the nuclear g factor and the mean doublet frequency is proportional to the hyperfine structure separation. Results obtained on Rb^{85} are in excellent agreement with previously published values, and indicate that the transition frequencies calculated from the Breit-Rabi energy-level equation agree with the experiment to better than one part per million. For the isotope Rb^{86}, the following values were obtained for the $^2S_{1/2}$ electronic ground state: $\Delta\nu = 3946.883(2)$ Mc, $g_I = -4.590(4) \times 10^{-4}$, $\mu_I = -1.6856(14)$nm. The hyperfine structure anomaly was found to be $\Delta = 0.17(9)\%$. Details of the apparatus constructed for the purpose of measuring these anomalies in radioactive alkali isotopes are presented, as well as the comparison of the experimental result with values predicted for the anomaly by using various nuclear models and the Bohr-Weisskopf theory. (auth)

18435 UCRL-9174

California. Univ., Berkeley. Lawrence Radiation Lab. SOME NUCLEAR AND ELECTRONIC GROUND-STATE PROPERTIES OF Pa^{233}, Am^{241}, AND 16-hr Am^{242} (thesis). Joseph Winocur. Apr. 13, 1960. 128p. Contract W-7405-eng-48. OTS.

The atomic-beam, magnetic-resonance method was used to study some properties of the nuclear ground-state and the low-lying electronic states of three radioactive actinide isotopes; Am^{241}, Am^{242}, and Pa^{233}. Confirmations of earlier measurements made by optical spectroscopy are noted in the tabulated results. The observed electronic energy levels of protactinium very probably arise from the configuration $(5f)^2$ (6d) $(7s)^2$. Experimental transition intensities indicate that the ordering of these levels is probably inverted. From the observed hfs constants of Pa^{233} and detailed calculations involving the electronic wave functions, the following values of the nuclear moments are inferred: $\mu_I(Pa^{233}) = +2.1$ nm, $Q(Pa^{233}) = -3.0$ barns. From the ratios of the hfs constants of the two americium isotopes, together with the optically measured nuclear moments of Am^{241}, it follows that $\mu_I(Am^{242}) = \pm 0.33$ nm and $Q(Am^{242}) = \mp 2.76$ barns. A description of the experimental technique, and an analysis of the results are presented. (auth)

18436 WASH-1028

Nuclear Cross Sections Advisory Group, AEC. REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP, WASHINGTON, D. C., APRIL 28-29, 1960. John A. Harvey. 76p. OTS.

The cross section measurement programs at ANL, BNL, Columbia Univ., Duke Univ., Hanford Laboratories, LASL, ORNL, Phillips Petroleum, Rice Institute, and UCLRL are reviewed. An informal statement is given of recent developments, changes of emphasis, and preliminary data which are of importance to the cross section measurement program of the AEC. (For preceding report see WASH-1026.) (W.D.M.)

18437 AEC-tr-4113

ON THE ENERGY DISTRIBUTION OF RECOILING ATOMS FOLLOWING (n,γ) REACTIONS. I. Zvara. Translated by Chi-hua (Ruth) Hsiung (Michigan Univ.) from Vestnik Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim., 13, No. 6, 127-38(1959). 19p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 3046.

18438

AN ILLUSTRATION OF A TYPE OF TRIPLE CORRELATION MEASUREMENT WHICH CAN BE EASILY INTERPRETED. A. E. Litherland and G. J. McCallum (National Research Council of Canada, Chalk River, Ont.). Can. J. Phys. 38, 927-40(1960) July.

The $Mg^{26}(He^4,n\gamma)Si^{29}$ reaction was used to illustrate the simplifications introduced in the interpretation of triple angular correlations by choosing a target and bombarding particles of zero spin and by observing the emitted particles, in this case neutrons, in a counter fixed at 0° to the beam. The angular correlations of the gamma rays with respect to the incident beam then depend only upon the properties of the final states in the residual nucleus. The angular correlation of the electric quadrupole 2.03-Mev gamma ray is predicted uniquely by theory and this prediction was verified experimentally. The angular correlations of the 1.28-Mev and 2.43-Mev gamma rays yielded for the E2/M1 amplitude mixing ratios $+0.25 \pm 0.05$ or -3.4 ± 0.5 and -0.26 ± 0.08 or -1.10 ± 0.16, respectively. In addition, the experiment provides an illustration of the value of the recently discovered technique of neutron-gamma-ray discrimination in an organic scintillator. (auth)

18439

ANGULAR CORRELATION OF INTERNAL CONVERSION PAIRS OF THE 3.560-Mev TRANSITION OF Li^6. Serge

Gorodetzky, Gilbert Sutter, Fernand Scheibling, Pierre Mennrath, Pierre Chevallier, and Raymond Armbruster. Compt. rend. 250, 3308-9(1960) May 16. (In French)

The de-excitation of the 3.560-Mev level of Li^6 formed by the $Be^9(p,\alpha)$ reaction was studied by the method of angular correlation of internal conversion pairs. The experimental points obtained normalized to the angle of 90° are shown together with the theoretical curves of the dipole electric moments, the quadrupole electric moments, and the dipole magnetic moments. From the results it is seen that the transition is either dipolar electric or quadrupolar electric. (J.S.R.)

18440

UTILIZATION OF THE UNCERTAINTY FUNCTION X(t) = 1 TO THE STUDY OF THE DISINTEGRATION LAWS OF RADIOELEMENTS. Gilbert Landaud and Claude Mabboux (Université, Caen, France). Compt. rend. 250, 3310-12 (1960) May 16. (In French)

The self-correlation function of the response of a system having two stable states when it is released by the pulses delivered by a particle detector exposed to the radiation of a radioactive element is calculated. The case of a disintegration is treated at two times corresponding to a radioactive daughter or to the presence of a metastable state. The proportion of the number of mothers to the number of daughters detected is taken into consideration. (tr-auth)

18441

OBSERVATION OF NUCLEAR RESONANCE OF IRON-57 IN NATURAL METALLIC IRON IN THE ABSENCE OF EXTERIOR FIELD. Claude Robert and Jacques-Michel Winter. Compt. rend. 250, 3831-3(1960) June 8. (In French)

The resonance of Fe^{57} was observed in a sample of natural iron in the ferromagnetic state. The variation of the resonance frequency with the temperature was studied. (tr-auth)

18442

THE RADIATIVE CAPTURE OF A NEUTRON ON Sc, Fe, Cu, Mo, Cd AND La NUCLEI. J. Urbanec, J. Kajfosz, and J. Kopecký. Czechoslov. J. Phys. 10, 275-83(1960). (In Russian)

The energies and intensities for transitions of a compound nucleus, produced by the capture of a neutron, were measured by means of a single-crystal scintillation spectrometer. The 20 to 1000 kev energies were measured on Sc, Fe, Cu, Mo, Cd, and La nuclei. (auth)

18443

EXCITATION OF Fe, Mn, AND Mg LEVELS BY INELASTIC NEUTRON SCATTERING. F. Lehar (Charles Univ., Prague) and J. Skřivánek and M. Veselá (Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys. 10, 335-6(1960). (In English)

The energy spectra of γ rays produced during inelastic scattering of neutrons on nuclei were measured in toroidal geometry by a crystal scintillation spectrometer. The resolving power of the spectrometer for Cs^{137} was 10%. When measuring Fe and Mn, the values of the energy lines and their errors were calculated from several independent measurements. The results for the measurements on iron, magnesium, and manganese are given. (B.O.G.)

18444

FURTHER STUDY OF THE REACTION $^7Li(\gamma t)^4He$. Mitsuo Miwa and Mikio Yamanouchi (Tokyo Univ. of Education). J. Phys. Soc. Japan 15, 947-51(1960) June. (In English)

The reaction $Li^7(\gamma,t)He^4$ is studied using betatron bremsstrahlung and nuclear emulsion. Resonance peaks are found in the excitation function at 7.8, 8.9, 9.8, and 13.5 Mev, in agreement with those found previously by one of the authors (Miwa). From the angular distribution analysis, it is concluded that the spin and the parity of the 8.9 Mev level in Li^7 is $5/2^+$ and even. (auth)

18445

REACTIONS OF ARGON-40 WITH ALPHA-PARTICLES. Shigeo Tanaka, Michiaki Furukawa, Takashi Mikumo, Shiro Iwata, Masuo Yagi, and Hiroshi Amano (Tokyo Univ.). J. Phys. Soc. Japan 15, 952-6(1960) June. (In English)

Excitation functions for the (α,p) and (α,pn) reactions of Ar^{40} were measured by the activation method using a modified stacked-foil technique. The results were compared with the predictions based on the statistical model of nuclear reaction by use of a level density expression of the form $\omega = c \exp[2(aE)^{1/2}]$. The experimental cross sections appear to agree with the calculated values for $r_0 \simeq 1.1 \times 10^{-13}$ cm and $a = 1 \sim 2$ Mev^{-1}. The considerably low value of r_0 might indicate that the statistical model is not completely applicable. (auth)

18446

ON THE FIRST AND THE SECOND EXCITED STATES IN Ge^{74}. Toshimitsu Yamazaki, Hidetsuga Ikegami, and Mitsuo Sakai (Tokyo Univ.). J. Phys. Soc. Japan 15, 957-64(1960) June. (In English)

The first and the second excited states in Ge^{74} were studied in detail from the decay of As^{74}. The possibility of the presence of 0 + excited level was checked by searching for an internal conversion line corresponding to E0 transition by means of a beta-ray spectrometer, but no detectable peak was observed. From the gamma-gamma coincidence measurements the relative intensity $T(2' \rightarrow 2)/T(2' \rightarrow 0)$ was obtained to be 1.7. From the gamma-gamma angular-correlation measurements the spin of the second excited state was assigned to be 2 and the E2/M1 mixing ratio δ in the $2' \rightarrow 2$ gamma transition was found to be $-(1^{+9}_{-0.5})$. These results were discussed in view of systematics on the medium-weight even-even nuclei. (auth)

18447

STRUCTURE OF GIANT RESONANCE IN $Al^{27}(p,\gamma)$ REACTION. Motoharu Kimura, Katsufusa Shoda, Naoshi Mutsuro, Tsutomu Tohei, Kazuo Sato, and Kunishige Kuroda (Tohoku Univ., Sendai) and Katumi Kuriyama and Tosimitu Akiba (Tokyo Univ. of Education). J. Phys. Soc. Japan 15, 1128-9(1960) June. (In English)

The 90° yields of gamma radiation produced from proton capture by Al^{27} were measured at proton energies of 7.5 to 14.5 Mev. The relative cross section data combined with these of Canberra revealed a giant resonance of width on the order of 4 Mev and with many peaks. Three resonances at 7.61, 8.75, and 10.13 Mev can be attributed to the excited state of Si^{28}. The giant resonance is interpreted from the standpoint of spheroidal deformation of a compound nucleus. (D.L.C.)

18448

PHOTOPROTONS FROM MEDIUM AND HEAVY ELEMENTS. W. C. Barber and V. J. Vanhuyse (Stanford Univ., Calif.). Nuclear Phys. 16, 381-401(1960) May (2). (In English)

Energy and angular distributions of protons produced by electron bombardment of Nb, In, Ta, and Au targets were measured. Yield curves as a function of electron energy to 40 Mev were measured for Nb, In, and Ta. The angular distributions are strongly forward for Ta and Au, less so for Nb, and slightly backward for In. The energy distributions are fairly smooth functions except in the case of Ta

where two peaks are observed at about 9.5 and 11.5 Mev. The yields were analyzed by means of a calculated number of photons (real and virtual) accompanying the electron through the target, and the following photoproton cross sections integrated over photon energy were obtained: Nb, 230 Mev·mb; In, 90 Mev·mb; Ta, 60 Mev·mb; and Au, 75 Mev·mb; the results have an estimated accuracy of ±25%. (auth)

18449

COMMENTS ON DAVYDOV AND FILLIPPOV'S THEORY OF THE PROPERTIES OF EVEN NUCLEI. T. Tamura and T. Udagawa (Tokyo Univ.). Nuclear Phys. 16, 460-73(1960) May (2). (In English)

It is shown that all the experimental data on even nuclei, which the theory of Davydov and Filippov explains, can as well be explained by more conventional theories. It is further shown that there exist several experimental data in which the theory of Davydov and Filippov may meet with difficulty but which could be explained by the conventional theory. (auth)

18450

SYSTEMATICS OF ALPHA-RADIOACTIVITY IN THE RARE EARTH REGION. Kenneth S. Toth and John O. Rasmussen (Univ. of California, Berkeley). Nuclear Phys. 16, 474-91 (1960) May (2). (In English)

Alpha decay energy data in the rare earth region are extended by means of closed decay energy cycle calculations and are then correlated for each element as a function of neutron number. The marked effect of the closed shell at 82 neutrons on the alpha decay energies is discussed. Evidence is presented for a sharp drop at 90 neutrons in the normal alpha-decay energy versus neutron number trend, as well as for a proton subshell at 64 protons. Half-lives are calculated using a formula derived from simple barrier-penetration theory. The calculated values are compared with experimental half-lives and discrepancies are discussed. Reduced level widths δ^2 are determined for rare earth alpha emitters using barrier penetration factors calculated from the real potential derived by optical model analysis of alpha elastic scattering data. The reduced widths are in turn used to propose hindrance factors for odd-mass alpha emitters. (auth)

18451

ON THE DECAY OF $^{106}Rh^{m}$. O. J. Segaert and J. L. Demuynck (Rijksuniversiteit, Ghent). Nuclear Phys. 16, 492-501(1960) May (2). (In English)

The Rh^{106m} isotope was produced by irradiating Pd with 25-Mev deuterons. The beta and gamma radiations following the decay of 133 ± 4 min Rh^{106m} were investigated with scintillation spectrometers. The Rh^{106m} was found to decay mainly by 790, 950, 1180, and 1620 kev beta transitions. Gamma rays of 220, 407, 450, 512, 620, 735, 820, 1055, 1140, 1225, 1560, 1740, 1860, 2120, and 2280 kev were assigned with certainty. Relative intensities of the beta and gamma rays are reported. A tentative level scheme is proposed. (auth)

18452

COULOMB EXCITATION OF BETA- AND GAMMA-VIBRATIONAL STATES IN Sm^{152}. R. K. Sheline and H. L. Nielsen (Florida State Univ., Tallahassee) and A. Sperduto (Massachusetts Inst. of Tech., Cambridge). Nuclear Phys. 16, 518-28(1960) May (2). (In English)

A Sm^{152} target made by electromagnetic isotope separation was bombarded with 7.5 to 8.5 Mev deuterons and 8.6 Mev protons. Inelastic scattered groups corresponding to Coulomb excitation of the level at 122 kev were observed in every case, and in one run with 8.5 Mev deuterons Coulomb excitation of levels at 807 kev and 1079 kev was observed. The reduced transition probabilities to these states are measured as 4.1 ± 0.1, 0.07 ± 0.02, and 0.12 ± 0.02, respectively, in units of $e^2 \times 10^{-48}$ cm^4. The reduced transition probabilities for the two highest excited states are several times the single particle values. This is a strong indication of the collective nature of both these states. These levels are interpreted as beta- and gamma-vibrational states. The partial lifetime and the nuclear strength parameter for the E0-transition between the 807 kev and 122 kev levels were calculated from the experimental data and are found to be in poor agreement with the theoretical values. (auth)

18453

MEASUREMENT OF THE ENERGY OF THE WEAK GROUP IN THE α-SPECTRUM OF Po^{210}. T. Fényes (Inst. for Experimental Physics, Debrecen, Hungary). Nuclear Phys. 16, 529-33(1960) May (2). (In English)

The alpha spectrum of Po^{210} was examined by scintillation $\alpha-\gamma$ coincidence equipment combined with an electromagnetic α spectrometer. Accepting 5.3054 ± 0.0010 Mev as the value for the kinetic energy of the main group, that of the weak group was found to be 4.525 ± 0.005 Mev. (auth)

18454

CHARACTERISTICS OF HEAVY ION TRACKS IN NUCLEAR EMULSIONS. P. G. Roll and F. E. Steigert (Yale Univ., New Haven). Nuclear Phys. 16, 534-44(1960) May (2). (In English)

Ilford G-5 nuclear emulsion plates were exposed in vacuum to beams of He^4, B^{10}, B^{11}, C^{12}, N^{14}, O^{16}, F^{19}, and Ne^{20} ions. The ions were accelerated to about 10 Mev per amu, degraded to the desired energy by a variable thickness of metal foil or gas, and analyzed magnetically. Range-energy relations for these ions in dessicated G-5 emulsions were determined in this manner with an estimated accuracy of ±1%. Because the range-energy relations are intended for use in nuclear reaction experiments with machine-accelerated particles, no corrections were made for emulsion density. Comparison with similarly exposed Ilford emulsions of various different grain sizes and sensitivities indicates no significant dependence of the range-energy relation on emulsion type. The track width was measured as a function of residual range for all ion species used. (auth)

18455

NUCLEAR SHELL MODEL: HARTREE-FOCK APPROXIMATION WITH GAMMEL-THALER TWO-NUCLEON POTENTIAL. G. E. Tauber (Western Reserve Univ., Cleveland) and Ta-You Wu (National Research Council, Ottawa). Nuclear Phys. 16, 545-67(1960) June (1). (In English)

To investigate how suitable the Hartree-Fock approximation is for atomic nuclei, a calculation was carried out with the phenomenological two-nucleon potential $V(r_i - r_j)$ of Gammel-Thaler containing a repulsive core, a central, a tensor, and an $L \cdot S$ interaction. Harmonic oscillator wave functions are used for the one-nucleon wave functions. The parameters in the wave functions and a multiplicative parameter in $V(r_i - r_j)$ are determined from O^{16} by the variational principle and the empirical total energy. These (now fixed) parameters are then used to calculate the energy of the configuration $(1s)\nu^2\ (1p)\nu^5\ (1s)\pi^2\ (1p)\pi^6$ of O^{15}. It is found that the $L \cdot S$ term in $V(r_i - r_j)$ gives rise to a doublet $E(J = \frac{3}{2}) - E(J = \frac{1}{2}) = +31.6$ Mev. The total binding energy is $E(J = \frac{1}{2}) = -114.8$ Mev compared with the empirical value -111.97 Mev. The sign of this doublet corresponds, on the picture of the individual nucleon moving in an effective central

field and possessing an $l_i \cdot S_i$ interaction, to a sign of $l_i \cdot s_i$ opposite to that of the electron, and is in agreement with the fundamental hypothesis of the nuclear shell model of Mayer and of Jensen et al. The magnitude of the doublet, however, is too large, by a factor of about 5. These results are discussed. (auth)

18456

PARTIAL GAMMA RAY WIDTHS FOR LOW LYING LEVELS IN ALUMINIUM AND MAGNESIUM. F. R. Metzger, C. P. Swann, and V. K. Rasmussen (Franklin Inst., Swarthmore, Penna.). Nuclear Phys. 16, 568-90 (1960) June (1). (In English)

The gamma rays resulting from the bombardment of Al and Mg with protons of 3.3 to 4.2 Mev energy were used to excite low lying levels in Al^{27}, Mg^{24}, and Mg^{25}. Combining the results of self absorption and resonance scattering studies with measured branching ratios, the following partial widths Γ_0 for the ground state transitions were obtained: (1.01 Mev, $3/2+$) level in Al^{27}, $\Gamma_0 = 0.98\ \Gamma = 3.9 \pm 1.6 \times 10^{-4}$ ev; 2.21 Mev level in Al^{27}, $\Gamma_0 = 0.98\ \Gamma = (g_1/g_2)\ 2.4 \pm 0.3 \times 10^{-2}$ ev; (1.37 Mev, $2+$) level in Mg^{24}, $\Gamma_0 = \Gamma = 4.2 \pm 1.5 \times 10^{-4}$ ev; (1.61 Mev, $7/2+$) level in Mg^{25}, $\Gamma_0 = \Gamma = 3.0 \pm 1.5 \times 10^{-2}$ ev. The angular distribution of the 1.01-Mev resonance radiation was found to be of the form $W(\theta) = 1 + (0.02 \pm 0.13)P_2(\cos\theta)$, that of the 2.21-Mev radiation $W(\theta) = 1 + (0.23 \pm 0.03)P_2(\cos\theta)$. (auth)

18457

SEARCH FOR THE NATURAL ALPHA ACTIVITY OF TUNGSTEN. G. B. Beard and W. H. Kelly (Michigan State Univ., East Lansing). Nuclear Phys. 16, 591-6 (1960) June (1). (In English)

Scintillation properties of $CdWO_4$ and $CaWO_4$ crystals were studied and the crystals used in the search for natural alpha activity in tungsten. The relative scintillation efficiencies for gammas were found to be nearly the same for the two crystals and equal to approximately 0.1 of that of NaI(Tl). An external source of 5.3 Mev alpha particles produces approximately the same size pulses as 1.7 Mev gammas. The scintillation decay times were found to be 3.3 μsec and 3.9 μsec for $CaWO_4$ and $CdWO_4$, respectively. Background measurements were made with a 3.8 cm diameter × 0.64 cm NaI(Tl) crystal. No indication of an alpha activity of tungsten was seen. It is concluded that any tungsten alpha activity present corresponds to a half-life of greater than $8\ K \times 10^{17}$ yr where K is the relative isotopic abundance of the isotope undergoing decay. This is in disagreement with the previously reported half-life of $2.2\ K \times 10^{17}$ yr. (auth)

18458

COUPLING OF NUCLEAR ROTATION AND MOTION OF THE OUTER NUCLEON. A. S. Davydov (Lebedev Inst. of Physics, Moscow). Nuclear Phys. 16, 597-607(1960) June (1). (In English)

A theory of rotational states of odd mass nuclei is developed for the case when additional coupling between nuclear rotation and motion of the outer nucleon is introduced. The reduced probabilities for E2 and M1 transitions between the rotational states are computed. It is shown that the relative reduced probabilities are uniquely defined by the positions energy levels of the nucleus. (auth)

18459

DECAY OF Ba^{133}. M. K. Ramaswamy, W. L. Skeel, and P. S. Jastram (Ohio State Univ., Columbus). Nuclear Phys. 16, 619-24(1960) June (1). (In English)

The gamma rays following the electron-capture decay of 7.5 year Ba^{133} were studied by means of a coincidence scintillation spectrometer. Gamma rays at 79, 79, 274, 302, 358, and 381 kev were observed. In addition, the presence of a 56 kev gamma ray was confirmed. The resulting decay scheme with levels at 79, 158, 381, and 437 kev is in excellent agreement with previous work. Spin and parity assignments are made for these levels. (auth)

18460

SPECTRA OF γ-RAYS FROM NEUTRON CAPTURE BY HEAVY NUCLEI. [PART] I. L. V. Groshev, A. M. Demidov, and V. I. Pelekhov (Atomic Energy Inst., Academy of Sciences, Moscow). Nuclear Phys. 16, 645-56(1960) June (1). (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 14441.

18461

SPECTRA OF γ-RAYS FROM NEUTRON CAPTURE BY HEAVY NUCLEI. [PART] II. V. M. Strutinskii (Strutinski), L. V. Groshev, and M. K. Akimova (Atomic Energy Inst., Academy of Sciences, Moscow). Nuclear Phys. 16, 657-73(1960) June (1). (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 14442.

18462

CIRCULARLY POLARIZED GAMMA RAYS FROM DIRECT NUCLEAR REACTIONS. G. R. Satchler (Oak Ridge National Lab., Tenn.). Nuclear Phys. 16, 674-82(1960) June (1). (In English)

The residual nuclei following a reaction are left in a polarized state in general. One way of measuring this polarization is to observe any γ-rays the residual nucleus emits. Their angular distribution reveals the even moments of the polarization while their circular polarization depends upon the odd moments. Following a general discussion of circular polarization, and the predictions of the direct interaction picture of nuclear reactions, simple cases of stripping reactions and inelastic scattering are considered. Valuable information can be obtained concerning both the reaction mechanism and the reduced widths and nuclear spins involved. (auth)

18463

BRANCHING RATIOS OF K CAPTURE TO POSITRON EMISSION IN NON-UNIQUE FIRST FORBIDDEN $2^- \rightarrow 2^+$ BETA TRANSITIONS. J. Konijn, B. van Nooijen, and A. H. Wapstra (Technische Hogeschool, Delft, Netherlands). Nuclear Phys. 16, 683-9(1960) June (1). (In English)

The ratio of K capture to positron emission in $2^- \rightarrow 2^+$ transitions cannot always be explained by admixture of unique forbidden transitions in transitions having essentially an allowed K/β^+ ratio. On the other hand, the normal theory for transitions with $|\Delta J| = 1$ gives values for As^{74}, Rb^{84}, I^{126} and Tl^{200} which do not depend heavily on the actual values of matrix elements and which nearly agree with the experimental ones. (auth)

18464

THE NUCLEAR SURFACE IN AN EXCITED NUCLEUS. A. M. Lane (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and K. Parker (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Phys. 16, 690-7(1960) June (1). (In English)

Measurements of the alpha spectra from (p,α) reactions in medium weight nuclei suggested that the Coulomb barrier against alpha particle emission is considerably lower for the excited nucleus than for the ground state. In an attempt to confirm this suggestion theoretically the

variation of surface diffuseness with excitation energy was studied by considering a Fermi gas of nucleons in a semi-infinite potential with a diffuse edge. It is found that the calculated particle density shows very little variation with nuclear temperature. This suggests that the barrier penetrability should remain roughly constant up to 30 Mev. The variation of kinetic energy density in the nuclear surface was obtained as a by-product of the calculations. (auth)

18465

TOTAL ABSORPTION OF γ RADIATION BETWEEN 10 AND 30 Mev IN LIGHT NUCLEI. B. Ziegler (Technische Hochschule, Karlsruhe, Ger. and Max-Planck-Instituts für Chemie, Mainz). Nuclear Phys. 17, 238-49(1960) June (3). (In German)

Absorption cross sections in carbon, oxygen, and aluminum were determined with a 32 Mev betatron and a magnetic pair spectrometer in the energy interval between 10 and 30 Mev. In this region, where the nuclear absorption is unimportant, the measured total electronic absorption cross section agrees within 1% with the theoretical value based on the theories of Klein and Nishina for the Compton effect, of Bethe and Heitler for the pair production in the field of the nucleus, and of Borsellino for the pair production in the field of the electron. The total nuclear absorption shows the giant resonance peak well known in photonuclear reactions. The peak cross section was found to be 18 mb at 22.5 Mev for carbon and 50 mb at 20 Mev for aluminum. The oxygen and aluminum data suggest a smoothly varying nuclear absorption cross section. (auth)

18466

CLASSICAL THEORY OF COMPOUND NUCLEUS REACTIONS. Torleif Ericson (Massachusetts Inst. of Tech., Cambridge). Nuclear Phys. 17, 250-63(1960) June (3). (In English)

The emission of particles from a compound system to individual states in the residual nucleus is studied in the classical limit of large angular momenta. Expressions are derived for total and differential cross sections when the target spin is polarized and unpolarized under different initial and final conditions. It is found that the angular distribution has a very simple classical limit when the dependence of the penetrabilities of the emitted particle on angular momentum can be neglected. (auth)

18467

NEUTRON ENERGY LEVELS IN A DIFFUSE POTENTIAL. Arundhati Ghosh and N. C. Sil (Indian Assn. for the Cultivation of Science, Calcutta). Nuclear Phys. 17, 264-70 (1960) June (3). (In English)

The energy eigenvalues of neutrons within the nucleus for a spherically symmetrical potential $V(r) = -V_0[1 + \exp\{(r-R)/a\}]^{-1}$ are investigated by following a new method of Lanczos for solving the differential equation. The s- and p-state energy levels are calculated for atomic mass 200 with the values of parameters adopted by Feshbach et al. in their calculation of the neutron strength function with a similar potential. The results of the calculation agree closely with those of Malenka. (auth)

18468

ABSOLUTE DETERMINATION OF THE THRESHOLD VALUE OF THE REACTION $Li^7(p,n)Be^7$. Hans H. Staub and Hubert Winkler (Universität, Zurich). Nuclear Phys. 17, 271-8(1960) June (3). (In German)

The threshold proton energy of the reaction $Li^7(p,n)Be^7$ is measured using the magnetic deflection technique in a homogeneous 180° field. The procedure of extrapolation of the yield curve is presented. The final value obtained is 1880.3 ± 0.5 kev. A summary of all recent values of this threshold energy is presented. Revised values of resonance energies measured by Bumiller et al. are given as the present measurements allow an accurate correction for the permeability of the vacuum chamber. (auth)

18469

RESONANCE REACTIONS WITH GENERALIZED ONE-LEVEL APPROXIMATION. Harry Lustig (Univ. of Illinois, Urbana). Nuclear Phys. 17, 317-28(1960) June (3). (In English)

A formalism is developed for the analysis of nuclear reactions which involve partially overlapping resonance levels. The Wigner R matrix for each value of the total angular momentum and of the parity is divided into a single-level matrix and an energy-dependent background matrix. The collision matrix in the form defined by Blatt and Biedenharn may then be expressed for an N-channel reaction in terms of the N partial widths of the tagged level, N "potential" phase shifts, and the $\frac{1}{2}N(N+1)$ parameters of the unitary and symmetric background matrix. By invoking the unitarity and symmetry of the collision matrix itself, the number of independent parameters in the background matrix is then reduced to $\frac{1}{2}N(N-1)$. An explicit recipe is given for the construction of the collision matrix and is illustrated for N = 2 and N = 3. In this formalism, the separation between the strongly energy-dependent single-level part and the contributions from the background matrix is preserved throughout; the formalism will thus be practically useful when the latter varies slowly with energy in the region of the tagged resonance. Further simplifications which occur when the background matrix is diagonal or nearly diagonal are discussed. (auth)

18470

NUCLEAR POLARIZATION IN MESIC ATOMS OF DEUTERIUM. M. Demeur and Ch. Joachain (Université Libre, Brussels). Nuclear Phys. 17, 329-38(1960) June (3). (In French)

The energy shift due to polarization of the deuteron by a bound mu-meson was evaluated. This effect compensates nearly the energy shift caused by the finite extension of the nucleus. Finite extension of the nucleons and D-state of the deuteron were neglected. (auth)

18471

PARAMETERS OF THE Lu^{176} NEUTRON RESONANCE AT 0.142 ev. Joseph P. Roberge and Vance L. Sailor (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 7, 502-4(1960) June.

The total cross section of Lu^{176} was measured over the range of neutron energies from 0.02 to 0.25 ev. The data were taken with a sample enriched to 70.2% in Lu^{176}. The resonance at 0.142 ev in Lu^{176} was fitted to a Breit-Wigner single-level formula by the method of shape analysis. Parameters are presented for computing the activation cross section as a function of neutron energy over the region of measurement. (auth)

18472

RESULTS OF THE PHYSICS OF NUCLEAR FISSION. [PART] I. A. Kraut (Technische Hochschule, Munich). Nukleonik 2, 105-28(1960) May. (In German)

The experimental results obtained in the study of nuclear fission are reviewed. Theoretical results are referred to only for comparison. The topics discussed are the probability of fission by projectile particles, probability of photofission, half-value times of spontaneous fission, and distribution of fission products. (J.S.R.)

18473

ISOTOPIC SPIN SELECTION RULES. XIII. THE 6.92 Mev STATE OF O^{16} REVISITED. R. E. Pixley, J. V. Kane, and D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.). Phil. Mag. (8) 5, 359-64(1960) Apr.

The status of the possible E1—E3 cascade between the 2+ state at 6.92 Mev, the 3— state at 6.14 Mev and the 0+ ground state of O^{16} is reviewed in the light of recent improvements in our knowledge of radiative transitions and isotopic spin impurities. It is concluded that the present limit of 5×10^{-3} on the relative intensity, although clearly demonstrating the efficacy of the isotopic spin selection rule, is not sharp enough to be a significant test for detailed models of the nuclear structure, for which purpose an improvement by an order of magnitude would be required. It is shown by a coincidence method, using the reaction $F^{19}(p,\alpha)O^{16}$, that the relative intensity is less than 4×10^{-4}. This corresponds to $\alpha_0^2(1) < 2 \times 10^{-3}$, a low figure. (auth)

18474

ISOTOPIC SPIN SELECTION RULES. XIV. TRANSITIONS BETWEEN MIRROR STATES IN C^{13} AND N^{13}. J. V. Kane, R. E. Pixley, and D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.). Phil. Mag. (8) 5, 365-72(1960) Apr.

The 3.68 Mev 3/2— state of C^{13} is shown, by a coincidence technique to cascade via the 3.09 Mev 1/2+ state with a probability of $(6.5 \pm 1.0) \times 10^{-3}$. The rule that corresponding E1 transitions in mirror nuclei have the same reduced speed is used to deduce the speed of this weak branch from data available in N^{13} and hence to determine the radiative width of the M1 transition to ground from the 3.68 Mev state. This is (0.40 — 0.75) ev. The speed of this transition, which is not a mirror transition to the corresponding one in N^{13}, is compared with the prediction of the independent particle model. Agreement is obtained within the range of the intermediate coupling parameter a/K that satisfies other data in the A = 13 system. (auth)

18475

GAMMA RAYS FROM DEUTERON STRIPPING REACTIONS. G. R. Satchler (Oak Ridge National Lab., Tenn.) and W. Tobocman (Rice Inst., Houston, Tex.). Phys. Rev. 118, 1566-74(1960) June 15.

The distorted-wave Born approximation is used to calculate the p-γ angular correlation from several deuteron-stripping (d,p) reactions. One l = 2 and four l = 1 captures are considered. Optical potentials with rounded edges are used to distort the wave functions. In some cases the correlation is considerably changed from the pattern predicted by the plane wave Born approximation, and the distortion effects are strongly dependent on the direction of the emitted proton, and on the type of distortion assumed. Included is a general discussion of the theory of the (d,pγ) correlation. (auth)

18476

NUCLEAR SPIN AND HYPERFINE INTERACTION OF In^{113m}. W. J. Childs and L. S. Goodman (Argonne National Lab., Ill.). Phys. Rev. 118, 1578-81(1960) June 15.

The hyperfine structure of the 1.7-hr, 393-kev metastable state of In^{113} was studied by use of the atomic-beam magnetic-resonance technique. The nuclear spin was to be 1/2 and the magnetic dipole moment to be -0.21050 ± 0.00002 nm, subject to a possible hyperfine anomaly. The hyperfine separation in the atomic $P_{1/2}$ state was measured to be 781.084 ± 0.010 Mc/sec. (auth.)

18477

STUDIES OF LOW-LYING LEVELS OF EVEN-EVEN NUCLEI WITH (d,p) AND (d,t) REACTIONS. Bernard L. Cohen and Robert E. Price (Univ. of Pittsburgh). Phys. Rev. 118, 1582-90(1960) June 15.

Low-lying states of even-even nuclei in the vibrational region were studied by exciting them with (d,p) and (d,t) reactions. The relative cross sections for exciting ground states (G) bear little relationship to whether they are allowed or forbidden by the simple Mayer-Jensen configurations, so that configuration mixing is generally large. Some of the details of this mixing are obtained. The allowed portion of these cross sections are generally quite close to the single-particle values. First and second excited states are much more strongly excited than expected theoretically. In Pd^{104}, Pd^{106}, Pt^{194}, and Pt^{196} searches for the triplet in second excited states indicate that its total spacing must be less than 80 kev. New states were found in the triplet region of Cd^{114} and Cd^{112} bringing the total number of known states in these to 5 and 4, respectively; each includes two 0^+ and two 2^+ states. Higher excited states were studied and in almost all cases they occur below the expected position of the third member of the vibrational band; this gives evidence on the size of the energy gap. The location of all 0^+ levels up to 3 Mev is determined for several nuclei. In two cases the 3^+ states required by Davidov-Filipov theory are found to be 0^+, and in other cases they are not found at all. A number of previously unknown levels are catalogued. (auth)

18478

RADIOCHEMICAL STUDIES OF THE (p,pn) REACTION IN COMPLEX NUCLEI IN THE 80-450-Mev RANGE. Herbert P. Yule and Anthony Turkevich (Univ. of Chicago). Phys. Rev. 118, 1591-8(1960) June 15.

Excitation functions for the (p,pn) reaction were determined in the energy range 82 to 426 Mev for the target nuclei F^{19}, Cu^{65}, and Au^{197}. The absolute values were based on the excitation function for the reaction $C^{12}(p,pn)C^{11}$. These excitation functions exhibited a general decrease with energy and the cross sections were between 122 mb for Au^{196} at 82 Mev and 23 mb for F^{18} at 426 Mev. An excitation function for the reaction $Al^{27}(p,3pn)Na^{24}$ was also found. The results of Monte Carlo nuclear cascade calculations were used to predict these (p,pn) excitation functions. The theoretical results were compared with experimental results of this and other reports. Agreement was obtained for the $F^{19}(p,pn)F^{18}$ excitation function and an extrapolation of the Monte Carlo results. The theoretical excitation functions were about one-half the experimental results for the $Cu^{65}(p,pn)Cu^{64}$ reaction and about one-third the experimental results for $Au^{197}(p,pn)Au^{196}$. The effects on the Monte Carlo calculations of a variation in the radius parameter were examined. (auth)

18479

SPINS AND DECAY MODES OF CERTAIN NEUTRON-DEFICIENT SILVER ISOTOPES. O. Ames, A. M. Bernstein, M. H. Brennan, R. A. Haberstroh, and D. R. Hamilton (Princeton Univ., N. J.). Phys. Rev. 118, 1599-1604(1960) June 15.

Isotopically enriched Pd foils were bombarded with protons to determine the origin of the 1.2-hr activity which was previously discovered in an even-A Ag isotope. The only appropriate activity was found in Ag^{104} which was observed to have a (69 ± 3)-min

predominantly K-capture activity with intense γ rays of 550, 764, and 920 kev. Using the atomic beam magnetic resonance method it was verified that the 69-min activity has I = 5. The I = 2 resonance in Ag^{104}, when counted in an x-ray detector, was found to decay with a 69-min half-life with a small admixture of a 27-min component. When viewed in a β counter, only the 27-min component was observed. These characteristics of the I = 2 resonance were explained by placing the I = 2 level above the I = 5 level with an appreciable amount of isomeric transition. This interpretation was supported by the observation of feeding in the 920-kev γ ray which only occurred in the decay of the I = 5 state. Further work with isotopically-enriched Pd foils showed γ rays of 120 and 150 kev, and, tentatively, 260 kev which were assigned to the decay of 59-min Ag^{103}. A positive identification of a (15 ± 2)-min activity in Ag^{102} was made. (auth)

18480

ANGULAR DISTRIBUTION OF FRAGMENTS FROM FISSION OF Au^{197} WITH CARBON IONS. Glen E. Gordon, Almon E. Larsh, and Torbjørn Sikkeland (Univ. of California, Berkeley). Phys. Rev. 118, 1610-11(1960) June 15.

The kinetic energy and angular distribution of fragments from fission of Au^{197} with 123- and 93-Mev carbon ions were determined by observation of the fragments in gas scintillation and solid-state detectors. Between 20 deg and 160 deg in the center-of-mass system, both angular distributions lie slightly above a $1/\sin\theta$ curve, falling below it beyond those angles. The anisotropies $[\sigma(0°)/\sigma(90°)]$ are 4.7 and 3.8 for 123- and 93-Mev carbon ions, respectively. The most probable fragment kinetic energies in the center-of-mass system are 73 ± 3 Mev and 71 ± 3 Mev. (auth)

18481

SOME CROSS SECTIONS FOR THE PRODUCTION OF RADIO-NUCLIDES IN THE BOMBARDMENT OF C, N, O, AND Fe BY MEDIUM ENERGY PROTONS. Masatake Honda and Devendra Lal (Scripps Institution of Oceanography, La Jolla, Calif.). Phys. Rev. 118, 1618-25(1960) June 15.

A number of nuclide formation cross sections were measured, using the Berkeley 184-in. cyclotron, to assist in the interpretation of the data on cosmic-ray-produced nuclides in the atmosphere and in iron meteorites. Cross sections of H^3 and Be^7 were measured in bombardments of organic targets containing nitrogen and oxygen by protons of energy 225 to 730 Mev. Semicarbazide (CH_5N_3O) targets were used to obtain cross sections in air nuclei. The targets were prepared by mixing with a few percent of aluminum dust to permit reliable monitoring of the beam. Polyethylene, aluminum lactate, and Plexiglas targets provided elementary cross sections in carbon and oxygen. The cross sections for the production of the long lived isotopes Cl^{36} (3×10^5 yr) and Al^{26} (8×10^5 yr) at 730 Mev, and of a number of short lived radionuclides at 500 and 730 Mev, in iron bombardment by protons were measured. These data and those of earlier workers suggested some modifications in empirical relations used for predicting spallation cross sections in the case of nuclides close to stability. (auth)

18482

EQUILIBRIUM DEFORMATION OF Ra^{226}. Ila Dutt and Paresh Mukherjee (Saha Inst. of Nuclear Physics, Calcutta). Progr. Theoret. Phys. (Kyoto) 22, 814-18(1959) Dec. (In English)

The hamiltonian of a single particle moving in a pear-shaped potential is discussed. In order to investigate the effect of spin-orbit coupling in a field of octupole deformation a simpler radial form is suggested. A Nilsson's representation is chosen and eigenvalues are calculated using second order perturbation. It is shown that in order to explain the occurrence of the 253 Kev (1−) level in Ra^{226}, the octupole deformation parameter a_3 comes out to be 0.02. (auth)

18483

SEMI-PHENOMENOLOGICAL INTERPRETATION OF THE OPTICAL MODEL IN NUCLEAR REACTIONS FROM THE POINT OF VIEW OF FLUCTUATION-DISSIPATION THEOREM. Mikio Namiki (Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto) 22, 843-56(1959) Dec. (In English)

The behavior of the nuclear optical model in the elastic scattering of neutrons at low energies is investigated on the theoretical basis of the fluctuation-dissipation theorem. The theory starts from a Schrödinger equation with the optical potential and the fluctuating source function. The source function, a representative of motions of the compound nucleus, is subject to the fluctuation-dissipation theorem, in which the imaginary part of the optical potential is proportional to the correlation function of the fluctuating source function. It is found that the strength function characterizing nuclear reactions is represented by the Fourier transform of the correlation function of the fluctuating wave function, and that the average rate of energy dissipation of the compound nucleus is proportional to the strength function and temperature of the compound nucleus. (auth)

18484

LOWER LEVELS IN Ca^{43}. Toshiya Komoda (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto) 22, 891-3(1959) Dec. (In English)

The lower levels (J = $\frac{7}{2}$, $\frac{5}{2}$, and $\frac{3}{2}$) of Ca^{43} are calculated using the method of configuration mixing and the independent particle model. 10, 9, and 8 configurations are assumed for the $\frac{7}{2}$, $\frac{5}{2}$, and $\frac{3}{2}$ levels, respectively, and the results are put into the form of a function of the range parameter for various values of the spin mixture parameter. The $\frac{7}{2}$ and $\frac{5}{2}$ levels are found to be very close together with $\frac{7}{2}$ being the ground state and the $\frac{3}{2}$ level to be the second excited state, agreeing with experimental data. (D.L.C.)

18485

INCLUSION OF HOLE MOTIONS IN THE BRUECKNER THEORY. Fumiaki Iwamoto (Tokyo Univ.). Progr. Theoret Phys. (Kyoto) 22, 903-5(1959) Dec. (In English)

The Brueckner theory of nuclear saturation is expanded to include the motion of holes by solving the two-body equation (Bethe-Goldstone) for the case of processes occurring inside the Fermi sea. Equations are given for the amplitude of a physical hole pair or physical particle pair as compared with the physical N particle ground state and it is concluded that for this amplitude there is no healing distance. (D.L.C.)

18486

SPIN-ORBIT SPLITTING AND TENSOR FORCE. [PART] I. Tokuo Terasawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto) 23, 87-105(1960) Jan. (In English)

The effect of the tensor force on spin-orbit splitting in He^5 and N^{15} is examined by using the meson-theoretic potential and the phenomenological Serber potential, consistent with the experimental data of two-nucleon systems. About half of the experimental values of the spin-orbit splitting in the mentioned nuclei are obtained by the accurate computation of the second order effect in perturbation theory, whereas several previous calculations of this effect have yielded the splitting of wrong sign or of too small

magnitude. The deformation of the closed shell core induced by the tensor interaction between the nucleons in the core is restricted so as to satisfy the Pauli principle with the outside nucleon, and this restriction is responsible for the result of splitting energy. (auth)

18487

SPIN-ORBIT SPLITTING AND TENSOR FORCE. [PART] II. Akito Arima (Tokyo Univ.) and Tokuo Terasawa (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 115-36(1960) Jan. (In English)

General formulas of the second order perturbation energies due to the tensor force are given in the case of the closed shell + one nuclei, and useful formulas for calculating the two-body matrix elements are derived. Using these, the D-state doublet splitting in O^{17} is estimated and it is found that about half the observed value is explained in terms of the second order effect of the tensor force as in the case of He^5 and N^{15}. (auth)

18488

DIRECT CAPTURE OF SLOW NEUTRONS BY THE NUCLEAR p STATES. Haruhiko Morinaga and Chikai Ishii (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto) 23, 161-7(1960) Jan. (In English)

Cross sections for the capture of a slow neutron by unfilled bound p states are calculated with the p-state wave functions and slow neutron wave functions for a square well and a Woods-Saxon type potential in the case of Ca^{40}. The results are in good agreement with experiment. This suggests the possibility of obtaining minimum possible neutron cross sections for nuclei with given A. Also, neutron cross sections may give a sensitive test of nuclear potentials. (auth)

18489

MESON THEORETICAL POTENTIAL AND NUCLEAR PROPERTIES. Tatuya Sasakawa (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 168-70(1960) Jan. (In English)

The relationship of the meson potential to nuclear properties is derived with reference to the hard (repulsive) core. The nucleus is assumed to contain equal numbers of neutrons and protons, of which the part having spin up is equal to that having spin down, so that tensor forces do not contribute to the binding energy in first order. A hard core is shown to exist inside the main attractive part of the potential, which means that the one-pion-exchange is insignificant in the nuclear saturation. However, the surface contribution to the energy comes mainly from this exchange. (D.L.C.)

18490

ON THE HIGH ENERGY PROTONS INELASTICALLY SCATTERED FROM C^{12} AND O^{16}. Yoshiyuki Sakamoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 183-6 (1960) Jan. (In English)

In order to explain the resonances observed in the energy distribution of proton inelastic scattering by C^{12}, O^{16}, etc., in the range 19 to 22 Mev, the possibility is considered that the incident proton acts on the nucleons in the target nucleus through the nuclear interactions, which in turn contribute to the resonance peak. The t-matrix and nucleon-nucleon scattering phase shifts are used, and the calculated results agree fairly well with experimental values. (D.L.C.)

18491

ON THE MECHANICS OF NUCLEAR MODELS FOR INDEPENDENT PARTICLES. Ming Yü, Ch'ung-hua Chang, and Yu-Wêng Yü (Inst. of Nuclear Energy, Academy of Sciences). Wu Li Hsüeh Pao 15, 397-419(1959) Aug. (In Chinese)

The mechanics of the independent particle model shows that the volume effect is the resolving force in independent particle motion. Each nucleon near a saturated shell polarizes the surrounding nuclear substance and produces a nuclear cloud. Therefore, the magnetic moment and effective charge of the nucleon are somewhat varying while the angular moment and nucleon parity with the polarized nuclear cloud are conserved due to the law of angular moment and parity conservation. The probability of two-nucleon collisions in a nucleus is in reverse proportion to the nuclear volume Ω. The probability of three-nucleon collisions is proportional to nuclear volume Ω^2, etc. The data on nuclear energy levels calculated by the coupling theory coincide with the experimental data. Also in good agreement are the data on angular moment and parity of each nucleon obtained by means of nuclear models. However, calculations of the nuclear angular moment and probability of transition by means of shell model wave functions were not successful. (tr-auth)

18492

ON THE NUCLEAR SHELL STRUCTURE THEORY. Ming Yü (Inst. of Nuclear Energy, Academy of Sciences). Wu Li Hsüeh Pao 15, 420-39(1959) Aug. (In Chinese)

The problems of nucleon-nucleon interactions outside saturated shells are analyzed by perturbation methods. The method of wave expansion was developed for calculating Pb^{206}, Po^{210}, and Bi^{210} energy spectra. The results are in good agreement with experimental data. It was shown that nuclear energy spectra are determined by S-wave interactions. The interaction intensity is in agreement with the effective radius of nuclear force action and scattering path and does not depend on the shape of the nuclear force. In special cases P-wave interactions play an important part. The analysis showed that excluding the S-wave interactions the repulsive force of $^3P_0$ wave interactions is the strongest force between two nucleons. (tr-auth)

18493

ROTATIONAL SPECTRUM OF F^{19}. Hung-tao Shen, Tu-nan Yeuan, and Yang-kou Lee (Inst. of Atomic Energy Research, Academy of Sciences). Wu Li Hsüeh Pao 15, 440-6 (1959) Aug. (In Chinese)

The level spectrum of F^{19} is calculated by the rotational perturbation method. Results are compared with experimental data, and found to be in good agreement. The low energy level spectrum of F^{19} can be interpreted as the rotational band due to large deformation of the nucleus. (tr-auth)

18494

ENERGY LEVELS OF NUCLEI WITH ONE NUCLEON OUTSIDE THE SATURATED SHELL. Liang-yüan Chu, Tieh-yü Wang, and Ming Yü (Inst. of Nuclear Energy, Academy of Sciences). Wu Li Hsüeh Pao 15, 447-8(1959) Aug. (In Chinese)

The perturbation method was used for calculating the energy spectrum of nuclei with one nucleon outside the saturated shell. (R.V.J.)

18495

THE HYPERFINE STRUCTURE SEPARATION OF THE GROUNDSTATE $^2S_{1/2}$ AND THE MAGNETIC NUCLEAR DIPOLE MOMENT OF Au^{197}. Ekkehard Recknagel (Universität, Heidelberg, Ger.). Z. Physik 159, 19-32(1960). (In German)

The hyperfine structure of the ground state 6s $^2S_{1/2}$ and the nuclear magnetic dipole moment of gold-197 were

studied by the atomic beam magnetic resonance technique. The hyperfine structure separation $\Delta\nu$ was determined from $\Delta F = 1$ transitions. The magnetic dipole moment μ_I was measured by a direct method. The experiments yielded the following results: $\Delta\nu(^2S_{1/2}) = (6099{,}309 \pm 0{,}010)$ Mc/sec $\mu_I(Au^{197}) = +(0{,}1445 \pm 0{,}0014)\mu_K$. (auth)

18496

NUCLEAR RESONANCE ABSORPTION NONDOPPLER-BROADENED GAMMA RADIATION IN Re^{187}. Rudolf L. Mössbauer and Werner H. Wiedemann (Technische Hochschule, Munich and Kommission für Tieftemperaturforschung der Bayerischen Akademie der Wissenschaften, [Munich]). Z. Physik 159, 33-48(1960). (In German)

Nuclear resonant absorption of gamma rays was observed in nuclei of Re^{187} bound in a crystal lattice. At a temperature of 20°K a small fraction of the gamma quanta of the 134 kev transition to the ground state was emitted with essentially no energy lost to recoil, the recoil momentum being taken up by the entire crystal, not by the individual nucleus. Nuclei of Re^{187} similarly bound in a crystal lattice were irradiated with such gamma rays, resulting in an observable resonance absorption. Using a relative velocity of the order of 10 cm/sec, the line emitted with natural line width was shifted away from the absorption line, resulting in the destruction of the resonance phenomena. Analysis of the variation in transmission as a function of the Doppler shift of the emitted gamma ray gave a value of $\tau = (1{,}5 \pm 0{,}2) \times 10^{-11}$ sec for the lifetime of the 134 kev excited state in Re^{187}. (auth)

18497

CONCERNING THE NUCLEAR QUADRUPOLE MOMENT OF K^{40}. H. Bucka, H. Kopfermann, and J. Ney (Universität, Heidelberg, Ger.). Z. Physik 159, 49-50(1960). (In German)

The hyperfine structure of the $5\ ^2P_{3/2}$ state in the potassium spectrum was investigated in a K^{40} enriched probe with the help of the double resonance method. As a result, an additional maximum was added to the K^{40} spectrum at 13.8 ± 0.4 MHZ. The $5\ ^2P_{1/2}$ state was found to be composed of four hyperfine structure states with $F = 5/2, 7/2, 9/2, 11/2$. The values of Ritter and Series were compared with those calculated with allowance for quadrupole reciprocal effects on the transition frequencies. From the known frequency of the K^{39} transitions and the composition ratio of the isotopes used, the relative intensities of the frequencies of the transitions between $F = 5/2$ and $F = 7/2$ of K^{40} were estimated. (M.C.G.)

18498

THE DECAY OF THE 1.25 MINUTE NUCLEAR ISOMER Dy^{165m}. Rüdiger Tornau (Universität, Gottingen, Ger.). Z. Physik 159, 101-11(1960). (In German)

The decay of Dy^{165m} (1.25 min), produced by thermal neutron bombardment of Dy_2O_3, was studied with the aid of scintillation spectrometers. The ratio of cross sections for activation of Dy^{165m} (1.25 min) and Dy^{165} (2.3 hr was found to be 0.654 ± 0.017. The K-conversion coefficient of the 108.0 kev γ ray of Dy^{165m} was determined to be $\alpha_K = 3.62 \pm 0.22$, which agreed with the theoretical value for deexcitation by E_3 transition. The branching ratio of the decay of Dy^{165m} was (97.6 ± 0,3)% isomeric transition leading to the Dy^{165} ground state and (2.4 ± 0.3)% β-decay leading to excited states of Ho^{165}. The β-ray spectrum was measured for the first time and was composed of two components with maximum energies (890 ± 50) kev for (87 ± 5)% and (1020 ± 80) kev for (13 ± 5)%. The most probable spin assignments for the 515 and 356 kev states of Ho^{165} are $3/2^-$ and $3/2^+$, respectively. (auth)

18499

ELASTIC AND INELASTIC SCATTERING OF DEUTERONS BY ALUMINUM AT 11.8 Mev. A. Doehring, R. Jahr, and U. Schmidt-Rohr (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Z. Physik 159, 149-54(1960). (In German)

Using the 11.8 Mev deuteron beam of a cyclotron, a study was made of the angular dependence of the deuteron spectrum from interactions on Al^{27}. Separation of the deuterons from other products of the deuteron reactions was accomplished by recording $dE|dx$, measured by a three fold proportional counter, and E, measured by a three fold proportional counter, and E, measured by a CsI-counter, on an oscilloscope screen. The experimental inelastic angular distributions had the shape of a direct interaction process. The elastic angular distribution showed pronounced diffraction maxima. (auth)

18500

NUCLEAR ISOMERS OF $_{77}Ir^{192}$ AND $_{77}Ir^{194}$. Hans-Henning Hennies (Universität, Göttingen, Ger.). Z. Physik 159, 158-69(1960). (In German)

The β- and γ-radiation of Ir^{192} and Ir^{194}, produced by slow neutron irradiation, was studied with scintillation spectrometers. A new isomeric activity with a (47 ± 2) second-half life was found to be $Ir^{194\,m}$, decaying by a 130 kev-transition to Ir^{194} and by β-emission to excited states of Pt^{194}. Gamma rays of energy (130 ± 4), (323 ± 7), and (625 ± 20) kev were found. An upper limit for the conversion coefficient of the isomeric transition is given, which shows in connection with energy-half life-relations, that the 130 kev gamma ray is an E3 transition. (auth)

18501

DETERMINATION OF THE CONFIGURATION IN Bi^{210} FROM THE β-TRANSITIONS $Pb^{210} \rightarrow Bi^{210} \rightarrow Po^{210}$. Prabuddha Banerjee and H.-Dieter Zeh (Universität, Heidelberg, Ger.). Z. Physik 159, 170-7(1960). (In German)

From the anomalies in the β-decays of Pb^{210} and Bi^{210}, relations between the shell model wave functions of the ground states of Pb^{210}, Bi^{210}, and Po^{210} are derived. These relations are however not satisfied by wave functions calculated under the assumption of two-body central forces of zero range. Use was made of the fact that such forces seem to be a good approximation for even-even-nuclei (in the case Pb and Po), but not for odd-odd-nuclei (Bi in this case), and the wave function was derived for the 1^- level of Bi^{210} from the wave functions of Pb^{210} and Po^{210} using the relations obtained from the β-decay anomalies. (auth)

18502

MEASUREMENT OF THE HYPERFINE STRUCTURE SPLITTINGS OF THE $^4F_{9/2}$-GROUND STATE IN THE Co^{59}-I-SPECTRUM AND DETERMINATION OF THE QUADRUPOLE MOMENT OF THE Co^{59} NUCLEUS. D. v. Ehrenstein, H. Kopfermann, and S. Penselin (Universität, Heidelberg, Ger.). Z. Physik 159, 230-1(1960). (In German)

The hyperfine structure splittings of the electronic ground state $a^4F_{9/2}$ in the Co^{59}-I-spectrum were measured with a magnetic atomic-beam resonance-apparatus. From these splittings the magnetic dipole and electric quadrupole interaction constants are found to be $A(a^4F_{9/2}) = (450.284 \pm 0.01)$ Mc/sec, $B(a^4F\ ) = (139.63 \pm 0.5)$ Mc/sec. Taking into account the mixture of the $a^4F_{9/2}$ state with states of the same $3d^7\ 4s^2$-electron-configuration, an electric quadrupole

moment of Co^{59} of $Q = (0.404 \pm 0.04)\ 10^{-24}$ cm^2 was obtained. No Sternheimer-correction was included. (auth)

18503

EFFECTS OF HIGHER ORDERS ON THE ALLOWED β-DECAY OF Li^8. Karlheinz Krebs, Hans Rieseberg, and Volker Soergel (Universität, Freiburg i. B.). Z. Physik 159, 232-6(1960). (In German)

The $\beta-\alpha$ angular correlation of Li^8 was measured at electron energies of 3.5 and 7.0 Mev. The β-energies were selected by a magnetic lens spectrometer. Subtracting the contribution by kinematic effects, it was found for the $\cos^2\Theta$ term that $b = (1.9^{+2.6}_{-2.5})\%$ at 3.5 Mev and $(4.0^{+2.0}_{-1.5})\%$ at 7.0 Mev. This result is in reasonable agreement with theoretical predictions. (auth)

Particle Accelerators

18504 BNL-4808

Brookhaven National Lab., Upton, N. Y.

MINUTES OF MEETING OF ACCELERATOR DEVELOPMENT DEPARTMENT. May 11, 1960. J. Spiro. 3p. OTS.

The minutes for meetings No. 278 (January 25, 1960), 279 (February 16), and 280 (April 18) are given. In No. 280, the current status and parameters of the linac vacuum system are given along with an account of pumping problems. The operation of the r-f system of the linear accelerator is reviewed, and the design of a load for testing and trimming higher r-f levels is described. The outputs of the two final stages of the r-f system were successfully combined, and a beam was injected into the linac tank and accelerated to 50 Mev (April 13). The excessive input line fluctuations in the magnet pulsing at low levels are reported. (D.L.C.)

18505 UCRL-Trans-538

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy.

THE USE OF ROTOR TARGETS FOR THE DEVELOPMENT OF SECONDARY PARTICLES FROM THE SYNCHROPHASOTRON OF THE JOINT INSTITUTE FOR NUCLEAR RESEARCH. (Translation). I. B. Issinskii and K. P. Miznikov. 1960. 13p. JCL or LC.

In developing accelerated particles, it was found necessary to use targets of great dependability and fast action, and to be able to place them on any azimuthal coordinate of the ring of the accelerator. Therefore a rotor drive mechanism, based on the interaction of the current coil with the magnetic field of the accelerator, was developed for introducing targets weighing up to 500 gm into the working area of the synchrophasotron. These rotor targets found wide application for developing beams of secondary particles from the accelerator. Targets installed in the chamber of a synchrophasotron worked during the period between preventive inspections without any damage. With the use of rotor targets, several experiments were combined in one cycle of acceleration. (M.C.G.)

18506

PROBLEMATICS OF SEMI-RELATIVISTIC CIRCULAR ELECTRON ACCELERATORS WITH TIME-CONSTANT FIELD. L. Krlín (Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys. 10, 334-5(1960). (In German)

For continuous operation of an accelerator with time-constant field, both stability of the betatron oscillations and a constancy of the electron rotation time are necessary. It is not presently possible to fulfill both conditions simultaneously, and frequency modulation must be resorted to. An accelerator type is described which obviates this necessity. (T.R.H.)

18507

SOME ORIGINAL ASPECTS OF THE PRINCIPLE AND THE CONSTRUCTION OF THE 29-BEV PROTON SYNCHROTRON OF CERN. R. Gabillard (Université, Lille). Inds. atomiques 4, No. 3-4, 49-64(1960). (In French)

The 29-Bev proton synchrotron at CERN operates with alternating gradient focusing. The principle of alternating gradient focusing is briefly described, and the difficulties imposed by strong focusing are discussed. The foundations of the synchrotron and the construction and feed of the magnet are considered. The principles of the beam control are then briefly discussed. (J.S.R.)

18508

SATURNE: THE SACLAY PROTON SYNCHROTRON. [PART] II. R. Lévy-Mandel (Commissariat a l'Energie Atomique, Grenoble, France). Inds. atomiques 4, No. 3-4, 69-81(1960). (In French)

The review of the design and properties of the Saturn Proton Synchrotron is completed with a discussion of the feed for the electromagnet, the chamber and its pumping system, injector and injection optics, the acceleration system, the beam controls, and the foundations and shielding. (J.S.R.)

18509

ELECTROSTATIC ACCELERATION OF MICROPARTICLES TO HYPERVELOCITIES. H. Shelton, C. D. Hendricks, Jr., and R. F. Wuerker (Ramo-Wooldridge Div. of Thompson Ramo-Wooldridge, Inc., Los Angeles). J. Appl. Phys. 31, 1243-6(1960) July.

By electrostatic methods, μ-diam spheres of iron were accelerated to hypervelocities. Techniques were developed to give single impacts in vacuum of measured incident velocity, mass, and position. (auth)

18510

A LINEAR 4.5-Mev ELECTRON ACCELERATOR. O. A. Val'dner, O. S. Milovanov, G. A. Tyagunov (Tjagunov), and A. V. Shal'nov (Šal'nov). Kernenergie 1, 370-3(1958) May. (In German)

A linear electron accelerator is described which is made of two separate parts so that the construction elements of a circular accelerator can be used, one serving as electron injector and the other as accelerator. A magnetron is the high-frequency power source, and a Pierce electron gun feeds a 90 × 110 mm corrugated copper tube which is the first section of the accelerator. The second section is made up of rings and screws. The total energy of electrons after passing through the first section is 3.5 Mev; the increase in the second section is 2 Mev. The electron current is 30 ma. The injection energy is 50 kev. Results of experimental study of the parameters of the accelerator are given and discussed. (T.R.H.)

18511

DEFLECTION OF ION BEAMS IN A CYCLOTRON. P. P. Dmitrev (Dmitriev), N. N. Krasnov, and E. N. Chaprov. Kernenergie 1, 375-7(1958) May. (In German)

A study was made of beam extraction in a 1-meter cyclotron. The outer beam radius was 44 cm and deuterons in this orbit have an energy of 10.6 Mev. A shielded arc-ion source was used. The first experiments were conducted with an ordinary deflection system with flat electrodes. Then the effect of shims was studied. Experiments were also conducted with hyperbolic electrodes. (T.R.H.)

18512

THE CYCLOTRON OF THE CENTRAL INSTITUTE FOR

NUCLEAR PHYSICS AND THE RESEARCH PROPOSED IN THE AREA OF NUCLEAR PHYSICS. Josef Schintlmeister. p.25-42 of "Das Zentralinstitut für Kernphysik am Beginn Seiner Arbeit." Heinz Barwich, ed. Berlin, Akademie-Verlag, 1958. 59p. (In German)

The characteristics of the cyclotron are briefly described, and the maximum particle energies obtainable are tabulated. Resonance conditions are also given. The research aims of the Institute are discussed in more detail. These include the study of radioisotopes, and nuclear reactions. (J.S.R.)

Plasma Physics and Thermonuclear Processes

18513 AD-227710

California. Univ., Berkeley. Electronics Research Lab.
PLASMA WAVEGUIDES AS HIGH-Q STRUCTURES. A. J. Lichtenberg. Sept. 4, 1959. 44p.

The dispersion relation for propagation of an electromagnetic wave between the semi-infinite slabs of plasma is found. A fast wave solution exists with a sinusoidal field distribution in the free space region between the plasma slabs and exponential decay into the slabs, provided the plasma frequency is above the applied frequency. The fields can be made to decay very rapidly into the plasma so that all fields are far from metallic guide walls. A complex plasma frequency is introduced. The imaginary part of the plasma frequency is computed. The attenuation decreases with the third power of the electron velocity, giving extremely low attenuation for the high level case. The effects of temperature distribution and nonsharp plasma boundaries are considered and found to have small effects on the propagation constant, but no significant effect on the losses. The effect of a finite magnetic field is discussed qualitatively and it is concluded that for the cyclotron frequency above the plasma frequency there are no significant changes from the case treated. (auth)

18514 AD-232096

Radio Corp. of America. Astro-Electronic Products Div., Princeton, N. J.
RESEARCH ON PLASMA ACCELERATION BY ELECTRIC FIELD GRADIENT. Semi-annual Technical Report [for] June 30, 1959—December 31, 1959. Dec. 1959. 75p. Project 4766. Contract AF49(638)-658.

Theoretical and experimental studies of plasma acceleration by nonuniform r-f fields are presented. Theoretical considerations indicate that a plasma will be accelerated toward the low-field region if the applied frequency is greater than the plasma frequency and toward the high-field region if the frequency is less than the plasma frequency. Pulses of mercury plasma were generated in a reproducible way, and an r-f system was designed and operated. Phototubes and electron and ion pickup probes were used for detecting the moving plasma. Oscillograms show a change in plasma velocity as the r-f field is applied. (auth)

18515 PPL-TR-60-6

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.
PINCH DYNAMICS WITH NONUNIFORM INITIAL CONDITIONS. William J. Guman and Irving Granet. Jan. 1960. 24p. Contract Nonr-2851(00).

The basic equations of the "snow plow" pinch analysis were formulated in a constant area electrode geometry for the case of a pinch occurring in a fluid having initial velocity and density distributions. The geometry selected readily converts radial pinch motion to an axial motion. This new formulation can be applied to the well known case of uniform initial conditions and also to a different approach to the slug model which accounts for the internal energy in the fluid. (auth)

18516 R59SD428

General Electric Co. Missile and Space Vehicle Dept., Philadelphia.
TRANSPORT PROPERTY EQUATIONS FOR PARTIALLY IONIZED GASES. Charles W. Baulknight. Sept. 18, 1959. 15p. Contract AF04(647)-269.

Presented at the Fourth International Conference on Ionization Phenomena in Gases, Uppsala, Sweden, August 17-21, 1959.

Two types of systems are considered: Type I is a system of charged-charged particles and the Coulombic interaction potential is assumed. In type II, the system is composed of both charged and uncharged particle, i.e., $N^+ + N$, and $1/r^4$ potential is assumed. The $1/r^4$ term is corrected for the polarizabilities. Some typical results are presented for the diffusion, viscosity, and thermal conductivity coefficients for the charged-charge system in the temperature range of 10,000 to 15,000°K. (auth)

18517 R59SD431

General Electric Co. Missile and Space Vehicle Dept., Philadelphia.
ELECTRICAL AND PRESSURE LOSSES IN A MAGNETOHYDRODYNAMIC CHANNEL DUE TO END CURRENT LOOPS. George W. Sutton. July 22, 1959. 47p. Contract AF04(647)-269. (AD-227884)

The problem of end losses in a magnetohydrodynamic flow was studied for incompressible inviscid flow in a rectangular channel. Termination of the magnetic field at the ends of the electrodes lead to electrical losses which increase with decreasing aspect ratio of the electrode section of the channel. The losses are also increased with increasing values of the generator coefficient. These electrical losses can be corrected by extensions of the magnetic field beyond the electrode region, but these corrections adversely affect the net pressure change through the device. (auth)

18518 UCRL-5423-T

California. Univ., Livermore. Lawrence Radiation Lab.
ION CYCLOTRON WAVES IN MIRROR GEOMETRY. Harold P. Furth. Feb. 11, 1959. 6p. OTS.

The problems encountered in the excitation of ion cyclotron waves in a plasma by axial magnetic field oscillation are discussed. Several ways of eliminating the adverse effect of electron-induced radial fields are given. The advantages of using the high-impedance sheath drop at the P. I. G. cathodes are pointed out. Application to the ion magnetron is considered. (D.L.C.)

18519 UCRL-5903

California. Univ., Livermore. Lawrence Radiation Lab.
RECTANGULAR WAVE GUIDE CUSTOM INSTALLATIONS. Harlin L. Bunn. Apr. 1960. 9p. Contract W-7405-eng-48. OTS.

Methods used for forming wave guides for installation in microwave diagnostic systems for Project Sherwood are described. A machine designed for wave guide bending is described. A roller with a machined rectangular groove having the outside dimensions of the wave guide being bent was attached to the base plate at the right-hand end with a metal plate and pivoting pin. A bending arm on which was mounted a ball-bearing solid roller which pressed against the wave guide was attached to the pivot screw. Procedures

for forming bends and making twists were developed. (M.C.G.)

18520 UCRL-9019

California. Univ., Berkeley. Lawrence Radiation Lab. BIBLIOGRAPHY—CONTROLLED THERMONUCLEAR PROCESSES, LRL BERKELEY 1952-1958; LRL LIVERMORE 1953-1958. Margaret R. Thomas. Mar. 1959. 26p. Contract W-7405-eng-48. OTS.

A bibliography on the development of controlled thermonuclear processes (Sherwood Project) at Berkeley and Livermore is presented. (D.L.C.)

18521 UCRL-9144

California. Univ., Berkeley. Lawrence Radiation Lab. ENHANCED INTERACTION IN THE POSITIVE COLUMN. G. Ecker. Mar. 28, 1960. 43p. Contract W-7405-eng-48. OTS.

Recent theoretical work has shown that under certain conditions enhanced interaction may be present in a plasma. The influence of such enhanced interaction on the characteristics of the positive column in a longitudinal magnetic field is investigated. The calculations are based on the Boltzmann transport equations, using an effective interaction parameter. From the law of momentum conservation it appears that enhanced interaction causes enhanced diffusion by counteracting the influence of the magnetic field. Related to this is a pronounced influence on the radial potential distribution in the discharge. Both effects depend on the type of diffusion, showing characteristic differences between pure ambipolar diffusion, Simon diffusion, and intermediate types of diffusion. The law of particle conservation, which defines the electron temperature (T_-) in the discharge, is only indirectly—via the diffusion coefficient—influenced by enhanced interaction. This influence on the electron temperature is in general small. In particular it is shown that nonuniform enhancement may not affect T_- at all. The law of energy conservation yields, for a given electron temperature, an increase in the ion (T_+) and gas (T_0) temperatures, and with that an increase in T_+/T_-. More important, it shows that the relation $X_z(T_-)$ between the electron temperature and the longitudinal electric field (X_z) is strongly affected by enhanced interaction. Utilization of these results suggests a new method to investigate experimentally the presence of enhanced interaction in the discharge. This method is based essentially on the measurement of the radial potential distribution. (auth)

18522 WADC-TR-58-858

Forschungsinstitut für Physik der Strahlantriebe E. V., Stuttgart.

STOCHASTIC THEORY OF TRANSPORT PHENOMENA IN A REACTING PLASMA AT EXTREME TEMPERATURES. Final Report. H. J. Kaeppeler. Mar. 1958. 115p. Contract AF61(514)-1244. (AD-230245).

The development of an appropriate kinetic theory of non-equilibrium plasma behavior is given. Mathematical probability theory, especially the probability theory due to A. N. Kolmogoroff, is used to describe the behavior of a system of particles, a multi-component reacting plasma. An extension of Grad's method, including the presence of electric and magnetic fields, to the case of a non-isothermal multi-component reacting plasma is shown. Some fundamental concepts are discussed, such as the coordination of a continuous point manifold with a system of discrete events, definition of the generalized transport equation, and the hamiltonian for a system of charged particles with external fields. This study provided the fundamentals for a further development to give appropriate equations and computation methods for calculating plasma models using electronic data processing machines. (auth)

18523 NASA-TT-F-24

THE COMPLEX CONDUCTIVITY OF PLASMA OF AN ARC DISCHARGE SUPPORTED BY A DIRECT CURRENT. Jiri Kracik. Translated from Ceskoslov. casopis fys. 6, No. 3, 264-76 (1956). 15p. OTS.

An expression is sought for the complex conductivity of the plasma of an arc discharge supported by a strong d-c current for the case in which a very weak high-frequency current that does not affect the condition of the plasma passes through it. The agreement between the results found and previous notions is satisfactory. (auth)

18524

SOME CLASSES OF STATIONARY, TWO-DIMENSIONAL SOLUTIONS OF MAGNETO-GASDYNAMICS. F. Cap and E. Hofinger (Universität, Innsbruck, Austria). Acta Phys. Austriaca 13, 262-4(1960). (In German)

The motions of an ideal gas of finite electrical conductivity under the effect of magnetic fields are described approximately by the equations of magnetogasdynamics or magnetohydrodynamics, which are given. Little opposing motion of the single plasma components and adiapatic behavior are assumed. The solution of this system of nonlinear differential equations offers considerable mathematical difficulties so that only static solutions have been treated. A study is made to determine when stationary potential currents are possible in the presence of magnetic fields. (J.S.R.)

18525

HYDROMAGNETIC STABILITY OF A DIFFUSE LINEAR PINCH. William A. Newcomb (Univ. of California, Livermore). Ann. Phys. (N.Y.) 10, 232-67(1960) June.

The hydromagnetic energy principle is applied to the derivation of necessary and sufficient conditions for the hydromagnetic stability of a linear pinch with distributed plasma current (a diffuse linear pinch). The results are quite general in that the axial and azimuthal components of the magnetic field, which determine the structure of the pinch completely, are treated as arbitrary functions of distance from the axis. For purposes of illustration, the general results are applied to the limiting case of a pinch with the plasma current confined to an infinitely thin layer (a sharp pinch). (auth)

18526

ON BOGOLIUBOV'S KINETIC EQUATION FOR A SPATIALLY HOMOGENEOUS PLASMA. Andrew Lenard (Princeton Univ., N. J.). Ann. Phys. (N. Y.) 10, 390-400 (1960) July.

An integral equation, proposed by Bogoliubov, to determine the time development of the velocity distribution of a spatially homogeneous plasma is considered. It is shown that the time derivative of the velocity distribution can be expressed explicitly in terms of the distribution itself. The resulting kinetic equation has all the required properties, in particular, it satisfies the $\mathcal{H}$-theorem. By means of an excellent approximation it can be reduced to that derived by Landau. (auth)

18527

STATISTICAL MECHANICS OF PLASMA WITH SEVERAL COMPONENTS. Paul Cavaillès, Raymond Jancel, and Théo Kahan (Institut Henri Poincaré, Paris). Compt. rend. 250, 3282-4(1960) May 16. (In French)

The macroscopic equations of a plasma with several components (charged and neutral) were deduced from the Boltzmann equations. The results are applied to the phe-

nomenological equations of binary and ternary plasmas. (tr-auth)

18526

MAGNETOHYDRODYNAMICS OF A TERNARY PLASMA AND THE TYPES OF ASSOCIATED WAVE. Paul Cavailles, Raymond Jancel, and Théo Kahan (Institut Henri Poincaré, Paris). Compt. rend. 250, 3789-91(1960) June 8. (In French)

The results obtained previously (Compt. rend. 250, 3282(1960)) are used to establish the equations of the hydromagnetism of a ternary plasma. By linearizing these equations (oscillations of low amplitude), one obtains the dispersion equation of the medium which permits the analysis of the various modes of wave propagation. (tr-auth)

18529

LOSSES THROUGH BREMSSTRAHLUNG IN RELATIVISTIC AND ULTRA-RELATIVISTIC REGION OF ELECTRON TEMPERATURES OF PLASMA. J. Kvasnica (Charles Univ., Prague). Czechoslov. J. Phys. 10, 261-7(1960). (In English)

The losses through bremsstrahlung in a sufficiently diluted hydrogen plasma (plasma with infinitely large Debye-Hückel radius) are calculated for the relativistic ($kT \lesssim mc^2$) and ultra-relativistic ($kT \gg mc^2$) region of electron temperatures (m is the rest mass of the electron). In the ultra-relativistic temperature region the amount of energy I^{tot} emitted by 1 cm^3 of plasma per sec as a result of electron-ion and electron-electron collisions is given by $I^{tot} = 3.39 \times 10^{-29}\, n^2/\mu\, [1.86 + E_1(\mu)]$ Watt cm^{-3}, where n is the density of the ions (or electrons), $\mu = kT/mc^2$, and $E_1(\mu) = \int_\mu^\infty x^{-1} \exp(-x)\, dx$ is the integral exponent. The results are suitable for a plasma the density of which is $n \ll 10^{30}$ cm^{-3}. (auth)

18530

FORMATION OF CATHODE SPOTS AND CURRENT DENSITY DISTRIBUTION IN CATHODE SPOTS OF SHORT-TIME HIGH-INTENSITY ELECTRIC DISCHARGE. E. Žižka. Czechoslov. J. Phys. 10, 327-33(1960). (In Russian)

The connection between the current density distribution in a spot and the vapor jets was found for a short-time high-intensity electric discharge by studying the structure of partial cathode traces and measuring the current density on the cathode. The variation of the current density on the spot with the current gradient was found, and the etching of the cathode surface with ionic bombardment at a pressure of 760 mm Hg was observed. (auth)

18531

CALCULATION OF INCLINED SHOCK WAVES IN MAGNETIC GASDYNAMICS. M. I. Kiselev and N. I. Kolosnitsyn (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 773-5(1960) Apr. 1. (In Russian)

The tangential component of the magnetic field behind an inclined shock wave is determined by a cubic equation. (R.V.J.)

18532

ACCELERATION OF DISCHARGE PLASMA AND THE PRODUCTION OF STRONG SHOCK WAVES IN A CHAMBER WITH COAXIAL ELECTRODES. S. R. Kholev and D. S. Poltavchenko (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 1060-3(1960) Apr. 11. (In Russian)

Plasma acceleration by relatively continuous (one or several periods) radial discharge current interactions with concentric magnetic fields is analyzed. In addition to the acceleration, strong shock waves develop with a peculiar distribution of energy at temperatures where the constricted gas turns into plasma. A device consisting of two coaxial cylindrically shaped electrodes in a plexiglas chamber of 2 to 5 cm internal diameter and 50 to 90 cm long, with 150, 600, and 2400 μf capacity and initial potential of 5 to 6 kv is described. The results confirmed the efficiency of acceleration by this method. The shock wave and plasma velocities increased 1.5 to 2 fold in comparison to acceleration under similar conditions but without coaxial electrodes. Velocities of 30 to 80 km/sec were obtained at an initial air pressure of 0.7 to 0.02 mm mercury with an initial potential of 5 kv. (R.V.J.)

18533

ULTRA-HIGH-SPEED PHOTOGRAPHS REPUTING "COHESION IN PLASMA." W. C. Davis and A. W. Campbell (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys. 31, 1225-7(1960) July.

Photographs of the detonation of ca. 300 ml of dithekite-13 in a beaker are presented; the exposure times were 4, $\frac{1}{5}$, and $\frac{1}{100}$ μsec. Smear photographs indicate that the detonation velocity is 6800 m/sec, while the air shock velocity is 6900 m/sec near the top of the beaker. It is concluded that the phenomena are those of a shock wave and that no new assumption of cohesive force in a plasma is needed to interpret the pictures. Analysis of the shock wave interpretation shows it to be consistent with the known properties of air and the explosive used. (D.L.C.)

18534

LINEARIZED PLASMA OSCILLATIONS IN ARBITRARY ELECTRON VELOCITY DISTRIBUTIONS. George Backus (Masachusetts Inst. of Tech., Cambridge). J. Math. Phys. 1, 178-91(1960) May-June.

A mathematical examination is presented on the linearized small disturbances in the steady distribution $f_0(q)$ of the velocities q of the electrons in an electrostatic, collisionless plasma with motionless protons. It is assumed that $g_0(u) = \iint f_0(u,v,w)\,dvdw$ has an integrable derivative with respect to u for all axis orientations. An existence and uniqueness theorem for the initial value problem is given, and it is shown that no disturbance can grow faster than $\exp(\omega_p t)$, where ω_p is the electron plasma frequency. Consequently, one can base a stability theory on Laplace transforms with respect to time, as Landau has done. The limits of validity of Landau's stability criterion are explored: that $g_0(u)$ is stable if there are no wave numbers k for which $\mathcal{L}(s) = k^2\omega_p^{-2} - \int_{-\infty}^{\infty} g_0'(u)(u-s)^{-1}du$ has zeros in the upper complex s half-plane. To ensure instability, the zeros must have positive imaginary parts or a multiplicity of 2 or greater. To insure stability, the initial disturbance must be not only integrable, but square integrable with respect to u. The Maxwell distribution is unstable to certain integrable disturbances. All isotropic, three-dimensional distributions $f_0(q) = h(q^2)$ for which $x^{1/4}h(x)$ is absolutely continuous and square integrable, and $h(x) + 2xh'(x)$ is bounded, are stable to integrable, square integrable disturbances. This explains Van Kempen's ability to solve the initial value problem by superposing normal modes (solutions with complex, exponential time dependence) with real frequencies; he implicitly introduced stability by considering only isotropic distributions $f_0(q)$. His method is extended to unstable f_0 as a technique independent of Landau's for solving the initial value problem. If f_0 is unstable, the normal modes are not complete, and a normal mode analysis can lead to erroneous positive conclusions about stability. Finally, the linear theory predicts that in stable plasmas the neglected term will grow linearly with time at

a rate proportional to the initial disturbance amplitude, destroying the validity of the linear theory, and vitiating positive conclusions about stability based on it. In a thermonuclear plasma with $T = 10^8$ °K and $N = 10^{15}$ electrons/cm^3, a disturbance of wavelength 1 cm and initial amplitude 1 v can no longer be treated by the linear theory after 220 μsec. (auth)

18535

NON-LINEAR EFFECTS ON ELECTRON-PLASMA OSCILLATIONS. Masao Sumi (Electrical Communication Lab., Tokyo). J. Phys. Soc. Japan 15, 1086-93(1960) June. (In English)

Nonlinear effects are investigated in the excitation of electron-plasma oscillations by considering a nonlinear term in the Boltzmann equation as a perturbation. With the growth of the fundamental component, the second and the higher harmonics are generated as forced oscillations. The magnitudes of these components are estimated which give the criteria of validity of linear approximation. Finally the behavior of excited waves in the limit of large amplitude are described. (auth)

18536

OSCILLATIONS IN A PLASMA IN A WEAK MAGNETIC FIELD. Kiyoe Kato (Tokyo Univ. of Education). J. Phys. Soc. Japan 15, 1093-1101(1960) June. (In English)

The oscillations in a bounded plasma in an external magnetic field were studied. The hot cathode discharge tubes used were filled with mercury vapor at pressure of the order of 10^{-3} mm Hg. The weak uniform magnetic field between 0 and 350 gauss was applied parallel to the direction of discharge current. The oscillations were detected by a super-regenerative detector adjusted to a constant frequency. Oscillations of two types were detected: one has a frequency which depends on the magnetic field strength alone, and the other has a frequency which depends on the electron concentration as well as the magnetic field strength. The former is interpreted as the cyclotron resonance oscillation, and the latter as the plasma type oscillation. (auth)

18537

TRANSPORT PROPERTIES OF PLASMAS IN A STRONG MAGNETIC FIELD. Taro Kihara, Yukio Midzuno, and Shobu Kaneko (Tokyo Univ.). J. Phys. Soc. Japan 15, 1101-7(1960) June. (In English)

Irreversible processes in plasmas in a strong magnetic field are discussed from both phenomenological and microscopic points of view. The thermodynamics of irreversible processes is applied and it is shown that the Onsager-Casimir reciprocity relation takes a symmetrical form for plasmas in a magnetic field. For a two-component fully ionized gas where the electrons make many free gyrations, interference between electrical and thermal conductions vanish. When the mean gyration radius r_g of the electrons is shorter than the Debye length l_D, the diagonal elements of tensors of the electric conductivity and diffusion coefficient perpendicular to the magnetic field are proportional to $\ln(kTl_D/Ze^2) + (3/4)[\ln(l_D/r_g)]^2$, where Ze and $-e$ are the charges of an ion and electron, respectively. (auth)

18538

ION MIRRORS AND ROTATING PLASMAS. J. Kistemaker (F.O.M. Laboratorium v. Massaspectrografie, Amsterdam). Ned. Tijdschr. Natuurk. 25, 185-202(1959) July. (In Dutch)

One of the primary problems in fusion research is that of plasma containment. Some aspects of experimentation on magnetic containment are considered. The mirror effect, plasma formed in a magnetic bottle, ion magnetron and Ixion, and the DCX and Ogra are discussed. (J.S.R.)

18539

IONIC CONDUCTIVITY OF HIGHLY IONIZED PLASMAS. M. Sakuntala, A. von Engel, and R. G. Fowler (Univ. of Oklahoma, Norman). Phys. Rev. 118, 1459-65(1960) June 15.

When a cloud of highly ionized gas ejected by a plasma shock tube is made to travel across a constant magnetic field, an electromotive force is produced in the plasma in a direction normal to both the field and the plasma path. Using two probes facing one another this electromotive force was measured with an oscillograph. Its maximum value was found to be proportional to the field and the probe separation. By taking the maximum probe potential for different values of the external resistance between the probes, the lowest value of the "resistivity of the plasma" as measured by a current entering and leaving it was obtained. The resistivity was shown to be independent of the magnetic field, the collecting area, the separation and surface state of the probes. All experiments were made in hydrogen at a gas pressure between 0.5 and 5 mm Hg with a nearly critically damped current pulse of order 10^4 amperes lasting for about 6–8 μsec and fields <2000 gauss. The plasma resistivity between the probes was found to be of the order 1 ohm cm at a gas pressure of a few mm of Hg. This is about 100 times larger than the electronic resistivity of a fully ionized gas for current circulating internally. The measured values of the plasma resistivity agree with the results obtained from theory based on ionic conduction in the plasma which is here the necessary prerequisite for maintaining the electric neutrality of the moving plasma. From the measured probe voltage the flow velocity of the plasma was derived. Its variation with gas pressure agrees with shock wave theory. (auth)

18540

EQUATION OF STATE OF HIGH TEMPERATURE PLASMA. Tohru Morita (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto) 22, 757-74(1959) Dec. (In English)

The equation of state of high temperature plasmas is investigated using quantum mechanics, and it is shown that the Debye-Hückel approximation applies to the plasmas of low density of the order $10^{15} \sim 10^{17}$ at high temperatures where $\lambda_e \lesssim a_0/Z$, where Z is the charge of a nucleus, λ_e the de Broglie wave length of an electron, and a_0 the Bohr radius. This result is obtained by reducing the problem to that of a suitable classical gas and confirming that the contribution of the watermelon terms (which is considered as the leading correction to the Debye-Hückel approximation) is negligible compared with that of the ring terms considered in the Debye-Hückel approximation. (auth)

Shielding

18541 AERE-R-3082

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A COMPUTER PROGRAMME FOR DETERMINING THE DISTRIBUTION OF PENETRATING NEUTRONS IN REACTOR SHIELDS. D. E. Bendall. Oct. 1959. 19p.

A program for use with the Ferranti mercury computer is described which evaluates the initial input source distribution data for the neutron shielding program RASH B. Alternatively, the program can be used to obtain the removal flux distribution through a reactor shield and core. The distribution of the average energy of the calculated

quantity is also obtainable if required. The application of this program is limited to large cylindrical or plane systems. (auth)

18542 NARF-60-11T
Convair, Fort Worth, Tex.
APPLICATION OF THE CARLSON S_n-METHOD TO CALCULATION OF NEUTRON ANGULAR AND TOTAL FLUX DISTRIBUTIONS IN A SPHERICALLY SYMMETRIC SHIELD. Theory and Preliminary Numerical Results. N. Edmonson, J. J. Henrick, and T. A. Moss. May 15, 1960. 121p. Contract AF33(600)-38946. (MR-N-253).

The S_n-method for calculating numerical approximations to solutions of the Boltzmann transport equation is developed for a spherically symmetric shield system. Anisotropic elastic scattering is assumed. Energy-group transfer coefficients are developed by using the Dirac δ-function and by a mapping procedure. Formulas for transforming cross-section data from the center-of-mass coordinate system to the laboratory coordinate system are given. A general matrix formulation for the anisotropic case is constructed. The procedures are applied to the computation of angular neutron distributions and total neutron distributions in water shields 80 and 120 cm in radius for Watt fission sources uniformly distributed in a small sphere concentric with the water shields. (auth)

18543 NDA-2130-2
Nuclear Development Corp. of America, White Plains, N. Y.
VALIDITY OF DIFFUSION THEORY FOR SHIELDING ANALYSIS. J. Agresta, M. Slater, and H. Soodak. Dec. 31, 1959. 42p. Project V. Contract AT(30-1)-2303. OTS.

The errors involved in the case of diffusion theory for handling one-velocity problems, as opposed to the more exact transport theory, were studied. Determinations of flux, given a distributed source, and of particle transmissions through finite regions were made. In each instance, transport theory solutions were obtained and compared with diffusion theory for various values of scattering-to-total cross section ratio and for various degrees of scattering anisotropy. Three types of problems were studied. An infinite medium with a source that varied sinusoidally with the single space coordinate y, a source which varied exponentially with the single space coordinate y in an infinite medium, and transmission of neutrons through finite slabs. Detailed discussions and tabulations were made for evaluation of diffusion theory. (M.C.G.)

18544
DETERMINATION OF THE EFFICIENCY OF A BORAL SHIELD AND MEASUREMENT OF THE QUANTITY OF BORON CONTAINED IN THIS SHIELD. R. Beaugé (Centre d'études Nucléaires, Fontenay-aux-Roses, France). Inds. atomiques 4, No. 3-4, 65-7(1960). (In French)

The neutrons coming from a reactor channel are not monochromatic, and their absorption does not follow a simple exponential law. The attenuation law for thermal neutrons counted by a boron counter is determined as a function of the thickness of an absorber in 1/v. (tr-auth)

18545
SCATTERING OF γ RAYS IN THE SHIELD LABYRINTH. Tsunesaburō Asada, Riichi Kikuchi, Takeshi Nogaito, and Yoshitake Kimura (Osaka Univ.). J. Atomic Energy Soc. Japan 2, 245-52(1960) May. (In Japanese)

In a Hot Cave labyrinth system, the dose rate of scattered γ rays was difficult to calculate accurately. An approximate formula was derived by which the dose rate of scattered γ rays coming out of the labyrinth is obtained. The value calculated by the approximate formula was compared with the measured value of the actual Hot Cave as well as with that of models and found to be almost identical, the error staying within 10%. In this formula, the multiple scattering inside the shielding was ignored and the scattering was taken as being isotropic. These approximations were shown to be satisfactory at the labyrinth where it bends at right angles. By this formula the labyrinth shape which should be adopted for Hot Caves in order to obtain the most effective shielding was computed. The calculated value was compared with the actual value measured in both a lead and ordinary concrete. (auth)

18546
ATTENUATION OF GAMMA RAYS FROM NEUTRON CAPTURE IN IRON–WATER MIXTURES. V. I. Kukhtevich (Kuchtevič) and S. G. Tsypin (Cypin). Kernenergie 1, 385-6 (1958) May. (In German)

The effects of Fe concentration in H_2O on the relaxation length of γ rays from neutron capture were studied. Neutrons from D(d,n) and T(D,n) reactions were used. The arrangement used was a tank with 60 cm^2 Fe plates with water spaces between. A 1.5-cm^3 ionization chamber detected the γ rays. Curves for 4-Mev and 14.9-Mev neutrons are given which both show a minimum γ relaxation length at 60 vol. % Fe. (T.R.H.)

Theoretical Physics

18547 NP-8714
Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.
ON A NEW METHOD IN THE QUANTUM FIELD THEORY WITH THE FIXED SOURCE. B. M. Barbashov and G. V. Efimov. 1960. 38p. (D-498)

A new method is suggested for solving the problems of quantum field theory with a fixed source. The formalism is independent of the magnitude of the coupling constant. It is based on the matrix methods for solving the linear differential equations developed by I. A. Lappo-Danilevsky. The solutions are obtained in the form of series for which a concrete form of the n-th order term is known. The S-matrices were obtained for a scalar charged and scalar symmetrical theory with a fixed source, as well as for the model advanced by Bialynicki-Birula. The renormalization constants are treated. In passing to a point interaction the renormalized charge in these models does not contain the logarithmic divergencies. (auth)

18548
SOME COMMENTS ON STATISTICAL THERMODYNAMICS. Ragnar Liljeblad (ASEA Västerås, Sweden). ASEA Research, No. 3, 29-40(1959). (In English)

An attempt is made to correlate the classical Boltzmann, the Bose-Einstein, and the Fermi statistics. This is made possible by modifying the presentation of the first-mentioned statistics. At the same time, a satisfactory reply is given to the criticism by Loschmidt and others of the inconsistency between the classical Boltzmann theory and the general laws of mechanics. It is pointed out that the customary usage of the term "particle" for something without identity for the image points in statistical thermodynamics is very misleading. It is suggested that such "particles," i.e., image points, should be considered as singularities in a field. (auth)

18549
STUDY OF THE SINGULAR ELECTROMAGNETIC FIELD

IN THE MINKOWSKI SPACE. Michel Cahen. Bull. classe sci., Acad. roy. Belg. (5) 46, 61-9(1960). (In French)

The Maxwell equations of the singular case are written in the spinor form. The conditions of integration are discussed. Equations satisfied by the field of isotropic vectors associated with the singular Maxwellian field are obtained. (tr-auth)

18550

THE VON NEUMANN THEOREM CONCERNING THE ESSENTIAL INDETERMINISM OF QUANTUM MECHANICS. Jésus Tharrats. Compt. rend. 250, 3786-8(1960) June 8. (In French)

The problem of the impossibility of cancelling the dispersion of all observable magnitudes is restudied by centralizing the question in the von Neumann theorem which is presented under a modified form. The von Neumann solution appears doubtful principally because the demonstration is made by projectors which do not represent observable magnitudes. (tr-auth)

18551

ON THE GREEN'S FUNCTION FOR A PARTICLE IN QUANTUM STATISTICAL MECHANICS. Roger Balian and Cyrano de Dominicis (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys. 16, 502-17(1960) May (2). (In French)

Some analytical properties of the mass operator are examined in perturbation theory, and a simple form of the one-particle Green's function for a grand canonical ensemble is obtained by analytical continuation. An approximation is then considered, which neglects terms where energy denominators are accidentally vanishing or equal. In this approximation, all quantities of interest can be diagrammatically built up like the corresponding ones for the ground state of a system of N particles; only the statistical factors for each state are no longer step functions in momentum space. The resulting expressions for "local" virial coefficients are examined; also the energy of the system fits in with the form Landau has assumed for his theory of Fermi liquids. In spite of difficulties arising from the use of a discrete spectrum of energies, this approximation is suggestive of what a more exact treatment could be. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

18552 AECL-990

Atomic Energy of Canada Ltd., Chalk River, Ont.

SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 176p. AECL.

The objective of the conference was to direct the attention of industry to the problem areas in reactor design, construction, and operation. Design, materials, corrosion, component manufacturing, quality control installation, and costs are considered. Separate abstracts were prepared for the fifteen papers presented at the symposium. (W.D.M.)

18553 AECL-990(Paper 3)

Atomic Energy of Canada Ltd., Chalk River, Ont.

REACTOR ENGINEERING PROBLEMS—I. S. H. Russell. Paper 3 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 12p.

To illustrate the application of reactor design principles the design of the reactor vessel for the NRU Reactor is discussed. Corrosion in the J-rod annulus that arose during operation of NRU and work necessary to overcome this difficulty are described in some detail. (W.D.M.)

18554 AECL-990(Paper 4)

Atomic Energy of Canada Ltd., Chalk River, Ont.

REACTOR ENGINEERING PROBLEMS—II. C. S. Northcote Paper 4 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 14p.

A brief description is given of some of the engineering problems encountered at Chalk River in the operation of ZEEP, ZED-2, NRX, NRU, and PTR. Problems associated with heavy water when it is used as a moderator or coolant, monitoring fuel elements to detect sheath failures, and the remote handling of equipment or processes are discussed. (W.D.M.)

18555 AECL-990(Paper 6)

Atomic Energy of Canada Ltd., Chalk River, Ont.

MECHANICAL MAINTENANCE OF REACTORS. F. A. Keetley. Paper 6 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 10p.

Particular maintenance problems associated with reactors are discussed by referring to the experiences and difficulties encountered with the NRU and NRX Reactors. Measures which can be taken to reduce maintenance problems are considered in some detail. (W.D.M.)

18556 AECL-990(Paper 7)

Atomic Energy of Canada Ltd., Chalk River, Ont.

PERFORMANCE OF REACTOR COMPONENTS. C. A. Herriott. Paper 7 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 12p.

To illustrate the problems associated with obtaining satisfactory operation of reactor components, three items are discussed in detail: helium blowers, pump seals, and shut-off rods. (W.D.M.)

18557 AECL-990(Paper 8)

Atomic Energy of Canada Ltd., Chalk River, Ont.

REACTOR MATERIALS. W. R. Thomas. Paper 8 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 13p.

The problems involved in choosing materials for reactor components are discussed with particular emphasis on the power reactors NPD, CANDU, and OCDRE. Core materials for water-cooled and organic-cooled reactors are listed, and some of their properties are given. Components external to the core are discussed briefly. (W.D.M.)

18558 ANL-6122(p.186-98)

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

ADVANCED EPITHERMAL THORIUM REACTOR CONCEPT. A. V. Campise, E. R. Cohen, and D. T. Eggen. p.186-98 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The potential of the Advanced Epithermal Thorium Reactor concept is discussed. Previously published cross-

sectional data on U^{233} from 0.454 kev to 6.065 Mev are evaluated by a reference core consisting of U^{233} in a 50% carbon-moderated core. (C.J.G.)

18559 ANL-6122(p.357-69)

Babcock and Wilcox Co. [Atomic Energy Div.], Lynchburg, Va.

MODERATOR CONTROL REACTOR. M. C. Edlund and R. A. Webb, Jr. p.357-69 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The operation and performance of the Moderator Control Reactor, which utilizes a varying mixture of D_2O and H_2O to control reactivity, are discussed. Calculations were made of the conversion ratio, breeding ratio, and effective resonance integral of Th^{232} as a function of D_2O concentration. The neutron balance was worked out for an equilibrium fuel. (C.J.G.)

18560 APEX-543

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

GENERAL REACTOR ANALYSIS COMPUTER PROGRAM FOR THE IBM 704, PROGRAM GEORGE. T. A. Hoffman and W. B. Henderson. Oct. 1959. 361p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

Program George is an IBM 704 code that combines standard ANPD reactor analysis methods for computing multiplication constant and spatial distribution of flux and power, as well as other nuclear parameters, in aircraft (heterogeneous) reactors. The elapsed time and the chance for human error between initial input and final output are greatly reduced in Program George. A matched set of reflector savings for a reflected, cylindrical core, which was formerly obtained by hand, is now computed by the program. In the C_2 portion of Program George, the code computes the neutron slowing-down density and flux at 19 lethargy levels plus a thermal group in bare, homogeneous compositions with normal mode, energy-dependent bucklings. The diffusion coefficient contains a transport correction as well as a Behrens correction for heterogeneous structure. Flux-depression factors at thermal and two epithermal levels are computed in annular, cylindrical geometry by one-energy, P_3 transport theory approximation in the I_2 portion of the program, or they may be given as input. Flux weighting of various cross sections, transmission factors, and other parameters are computed in a multigroup representation. Two-energy-group constants from the regional compositions are supplied in the F_2 portion of the program, in which a two-energy group, one-space-dimensional, multiregion diffusion calculation yields multiplication constant, normalized fission density, fast flux, and slow flux in each one-dimensional reactor portrayed. If a reactivity match is requested, the reflector savings of the specified compositions are adjusted until the multiplication constant in the radial F_2, longitudinal F_2, and the reference bare equivalent core of a cylindrical reflected reactor converge to the same value. (auth)

18561 APEX-556

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

HIGH-TEMPERATURE HYDRAULIC ROD CONTROL. May 1960. 92p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

The design and development of a hydraulic control actuator suitable for operation in a –65 to 500°F environment are described. The problems connected with such a design, including the development of components, are discussed, and recommendations for future development work suggested. (auth)

18562 ARF-4132-13

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

STUDIES OF REACTOR CONTAINMENT. Summary Report No. 2 [for] August 1, 1959 to January 31, 1960. T. A. Zaker, ed. Feb. 1960. 85p. Contract AT(11-1)-528. OTS.

Studies on the behavior of pressure waves in mixtures of water and its vapor were completed. The approximations involved in a fluid dynamic model of non-linear solids in a zone of extremely high stress intensity were investigated. A possible fluid equation of state for the solid was derived which gives an analytical fit to shock compression data previously determined. Calculations were made of the shock pressure and wave front geometry of a 1 kt point-source explosion in water in contact with low, average, and high density concretes. A two-shock configuration resulting from a pressure rise within the reactor vessel was determined. The interaction coefficients and boundary conditions governing a Mach configuration were investigated. Theoretical calculations of the dynamic compression properties of crushable solids by shock impingement experiments in a strong shock tube were made. Measurements of density and incident and reflected pressures for redwood, pine, balsa, celotex, foamglass, and styrofoam were made under conditions of shock compression. Modifications were made in the glass tube for controlled study of the explosive decompression of water. The effects of pressure magnitude and wave shapes associated with water hammer phenomena and pressure vessel diaphragm rupture characteristics were studied at 65 and 110°F. Apparatus and techniques were developed for the study of the behavior of porous materials when rapidly compressed. The displacement-time history of steel plates which were accelerated by means of explosives and retarded by porous materials, such as wood or felted fibers, was observed. A method of analysis for the deformation of cylindrical shells with rigid end closures under static load was developed. The method is applicable to cases of dynamic loading in which the inertia effects are negligible. (For preceding period see ARF-4132-11.) (C.J.G.)

18563 BMI-1445

Battelle Memorial Inst., Columbus, Ohio.

HAZARDS SUMMARY REPORT FOR THE VMR CRITICAL-ASSEMBLY EXPERIMENTS. Richard A. Egen, William S. Hogan, David A. Dingee, and Joel W. Chastain. June 10, 1960. 78p. Contract W-7405-eng-92. OTS.

Critical experiments are described for the Variable Moderator Reactor (VMR), a reactor concept under investigation by American-Standard for the AEC. The VMR is light-water moderated and cooled and is fueled with slightly enriched uranium dioxide pellets loaded into aluminum tubes. The core consists of 37 hexagonal fuel cans each loaded with 61 fuel pins. The cooling water, which flows upward around the pins inside the fuel can, boils in passing through the core. Reactor control in the prototype will be achieved by varying the moderator height. The site, laboratory, and the critical assembly, including control and safety mechanisms, are described in detail. Special characteristics of the assembly pertinent to safety were calculated. The nuclear energy released and the average and maximum fuel temperatures resulting from step reactivity increases up to 2% $\Delta k/k$ are presented graphically for two cases. In the first case, fuel-temperature effects are considered to be the only shutdown mechanism; in the second

radiolytic gas is considered to contribute to shutdown, in addition to fuel-temperature effects. The accident considered to be the maximum credible accident causes a step addition in reactivity of 1.5% $\Delta k/k$. The nuclear-energy release is between 160 and 310 megawatt-sec depending on the assumed shutdown mechanisms. This accident does not cause any fuel to be vaporized (and probably none to be melted) and, hence, there does not appear to be a hazard from fission-product activity. It appears that this critical-assembly program can be conducted with reasonable assurance of safe operation and that no public persons will be jeopardized by its operation. (auth)

18564 CF-54-4-198(Rev.)

Oak Ridge School of Reactor Technology, Tenn. and Oak Ridge National Lab., Tenn.

REACTOR CHEMISTRY. Sigfred Peterson and R. W. Stoughton. May 12, 1954. Decl. May 3, 1960. 52p. OTS.

A treatise is given which is intended to serve as a text in the Oak Ridge School of Reactor Technology. It concerns those topics in chemistry most closely associated with reactor design and technology. There are discussions of transmutation products in reactor fuels, aqueous fuels, high-temperature nonmetallic liquid fuels, and liquid metal reactor fuels. (B.O.G.)

18565 CF-60-6-75

Oak Ridge National Lab., Tenn.

Na^{24} ACTIVITY IN THE HFIR PRIMARY COOLANT WATER. H. A. McLain. June 8, 1960. 8p. OTS.

Sodium-24, produced by the $Al^{27}(n,\alpha)Na^{24}$ reaction, has been found in the coolant of reactors using aluminum-clad fuel elements. Methods of calculating the activity due to sodium-24 are outlined. This activity was calculated to be normally 1.4×10^5 to 6×10^5 disintegrations per min per ml. The Na^{24} isotope disintegrates with 2.76- and 1.38-Mev gammas. (B.O.G.)

18566 CREL-918

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

LOGARITHMIC RATE MEASUREMENTS AT LOW REACTOR POWER LEVELS. C. R. Nixon and A. Pearson. Feb. 1960. 28p. (AECL-10[illegible]). AECL.

The response of a logarithmic rate amplifier to certain neutron power functions in the presence of a smoothing time constant at the logarithmic power amplifier input was investigated. It is concluded that a trip signal will always be received by the time the reactor power excursion reaches one decade regardless of how excessive the exponential power rise, or reactivity rate may be, when the initial conditions are an ion chamber current of 10^{-11} a and a trip level of 6%/S. (C.J.G.)

18567 DP-467

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

NEUTRON FLUX DISTRIBUTIONS IN NATURAL URANIUM TUBES (thesis). Thomas B. Ponder. Mar. 1960. 28p. Contract AT(07-2)-1. OTS.

Submitted to the Clemson Agricultural Coll.

Measurements were made in the Process Development Pile (PDP) of the distribution of the thermal neutron flux in ten different D_2O-moderated lattices of natural uranium tubes. Both single and double fuel tubes were used at lattice spacings of 7 and 14 inches. Special corrections were required for epithermal flux shielding by the manganese detector foils. After these corrections were applied, good agreement was obtained between the measured flux distributions and corresponding distributions calculated by the P_3 approximation to transport theory. (auth)

18568 GEAP-3279

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

METAL-WATER REACTIONS: VIII. PRELIMINARY CONSIDERATIONS OF THE EFFECTS OF A ZIRCALOY-WATER REACTION DURING A LOSS OF COOLANT ACCIDENT IN A NUCLEAR REACTOR. J. I. Owens, R. W. Lockhart, D. R. Iltis, and K. Hikido. Sept. 30, 1959. 38p. Project Agreement No. 1. Contract AT(04-3)-189. OTS.

Two preliminary analyses were made to determine the effect of a chemical reaction between steam and the fuel cladding in a nuclear reactor during a severe loss of coolant accident and prior to melting of the cladding. A pressurized water reactor configuration with rod type, Zircaloy-clad, low-enrichment UO_2 fuel elements was used to obtain core parameters for the evaluations. The results of the first analysis indicated core conditions such that the addition of chemical reaction heat would aggravate damage to the reactor, and provided a guide for evaluating various relationships and input data to develop an improved method of analysis. The second evaluation was somewhat more refined. The results of this analysis provided a preliminary evaluation of core conditions during a severe loss of coolant accident and indicated where additional improvements can be made in the method of analysis. It is apparent from the calculations that the heat generated by the oxidation of the Zircaloy significantly increases the cladding temperature as soon as the temperature exceeds about 2000°F. This autocatalytic effect causes varying amounts of clad oxidation prior to melting and a large variation of temperature between the hottest and coolest areas in the core. (auth)

18569 GEAP-3335

General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.

METAL–WATER REACTIONS: VII. REACTOR SAFETY ASPECTS OF METAL–WATER REACTIONS. Leo F. Epstein. Jan. 31, 1960. 79p. Contract AT(04-3)-189. OTS.

Results of a study concerned with the purely chemical effects of metals reacting with water following reactor core melt-down are presented. Conditions required for metal–water reactions are reviewed, and unsolved problems in these areas are discussed. It is noted that final resolution of the problem is not immediately in sight; however, a model has been developed which is useful as a guide for experiments. (J.R.D.)

18570 GEAP-3355

General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.

STATUS REPORT ON CONTROL ROD MATERIALS RESEARCH AND DEVELOPMENT PROGRAM. C. G. Andre, A. N. Holden, W. J. Ozeroff, and T. J. Pashos. Feb. 8, 1960. 55p. Contract AT(04-3)-189. OTS.

Material presented to the AEC in a review of the status of the Control Rod Materials Research and Development Program is listed. The purpose of this project is to provide scientific data and technology for control rod materials to be used in thermal and epithermal reactors. The materials should be suitable for use over a wide range of temperatures, extended operating periods, and various coolant environments. There are included a comparative and economic evaluation of control materials, corrosion studies, measurements of physical properties, experiments carried out on different control rod materials, and a survey of current and proposed work. (M.C.G.)

18571 HW-35481(Del.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SPECIFICATIONS FOR WAPD LOOP. J. A. Berberet. Feb. 16, 1955. Decl. June 10, 1960. 22p. OTS.

Specifications are given for an in-pile loop to be placed in the Hanford Reactor DR. (W.L.H.)

18572 HW-36174
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
EXPONENTIAL PILE MEASUREMENTS WITH HOLLOW SLUGS IN GRAPHITE–URANIUM LATTICES. E. D. Clayton. Apr. 12, 1955. Decl. Mar. 31, 1960. 32p. Contract W-31-109-Eng-52. OTS.

Buckling measurements were taken with hollow natural U slugs in graphite-moderated lattices, in which the lattice spacing was varied from $6\frac{3}{16}$ to 15 in. in 5 steps. The results of wet (water in the core) and dry measurements are reported. Buckling curves are given showing the effect on the buckling of coring the slug and placing water in the core. Simple three-region diffusion theory is applied to the measured lattices in an effort to correlate measurement with theory, but with only limited success. (auth)

18573 HW-60654(Rev.2)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
WATER LOSS RATES FOLLOWING A PIPING FAILURE IN THE PRTR. T. W. Ambrose. Feb. 4, 1960. 21p. Contract AT(45-1)-1350. OTS.

Four possible failures in the primary coolant system were analyzed, employing the most severe conditions considered credible. Primary coolant loss rates were calculated for the following postulated failures: a completely parted top header, a ruptured top header with hole area equal to that of the header cross section, and completely parted top and bottom jumpers. For all cases it was assumed that the steam drum remained pressurized and that the light water backup system failed to function. (C.J.G.)

18574 KAPL-2057
Knolls Atomic Power Lab., Schenectady, N. Y.
REACTOR SPECTRA EFFECTS ON FISSION FRAGMENT CROSS SECTIONS. C. R. Greenhow and E. C. Hansen. Dec. 1, 1959. 23p. Contract W-31-109-Eng-52. OTS.

The effects of epithermal neutron flux on the fission product buildup in a reactor were studied by programming the equations for the buildup on the IBM 704 for various ratios of epithermal flux to thermal flux. The assumption was made that all nuclei with a half life less than 50 hours decay immediately. The results indicate that in the use of B^{10} to match the thermal removal by fission products, the epithermal removal is underestimated by varying amounts depending on the ratio of epithermal flux to thermal flux. This error could be equivalent to a tie-up of reactivity affecting the calculated lifetime of a closely designed core. (D.L.C.)

18575 KAPL-2058
Knolls Atomic Power Lab., Schenectady, N. Y.
THE DEPLETION OF BURNABLE POISON IN ENDURANCE CALCULATIONS. R. C. Dahlberg and F. D. Judge. Mar. 1, 1960. 13p. Contract W-31-109-Eng-52. OTS.

Methods of relating the burnable poison concentration in a reactor to the fuel concentration during the life of the core are presented. These methods correspond to the following ways of using burnable poison: (1) in discrete lumps, (2) in a homogeneous mixture with the fuel, and (3) a combination of these. Nuclear data relevant to the U^{235}-B^{10} system are presented. (auth)

18576 KAPL-M-NCF-2
Knolls Atomic Power Lab., Schenectady, N. Y.
OXYGEN ACTIVITY IN WATER COOLED REACTORS. E. F. Clancy and N. C. Francis. Dec. 18, 1957. Decl. Mar. 28, 1960. 37p. Contract W-31-109-Eng-52. OTS.

In water cooled reactors, the coolant becomes radioactive due to the $O^{16}(n,p)N^{16}$ reaction. An accurate and simple method is presented for the calculation of oxygen activity in the core and reflector. Numerical results are presented for various water metal mixtures and core sizes. It is concluded that the activity can be reduced by simply adding metal to the core but keeping the amount of coolant water fixed. (auth)

18577 WAPD-221
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
DEVELOPMENT OF BORON-BEARING MATERIALS FOR APPLICATION AS LUMPED BURNABLE POISONS. D. Jaffe, E. F. Losco, and S. F. Kaufman. May 1960. 66p. Contract AT-11-1-GEN-14. OTS.

Several iron, stainless steel, and niobium-base boron-bearing materials containing 1 to 3 wt.% B^{10} were investigated for possible applications as lumped burnable poisons. Fabrication methods, mechanical and physical properties, and corrosion resistance were examined. On the basis of out-of-pile evaluation and some preliminary capsule irradiation data, the most promising materials were austenitic (Fe + 18 wt.% Cr + 15 wt.% Ni) and ferritic stainless steel (Fe + 18 wt.% Cr) alloys with less than 2 wt.% B^{10}. Cladding of these materials plus some additional iron and stainless steel base alloys with Zircaloy-2 was accomplished by roll bonding, using intermediate barrier materials. Sub-sized Zircaloy-2 clad poison plates were prepared for in-pile loop tests by roll bonding and compartmentation. Final selection of a poison material will be dependent on the results of the in-pile tests. (auth)

18578 AEC-tr-4011
Delft, Netherlands. Technische Hogeschool.
STUDY OF THE HEAT REMOVAL FROM A FUEL ELEMENT OF A NUCLEAR REACTOR OF THE BOILING WATER TYPE. Translated from thesis "Proeven Over de Warmte-Afvoer van een Splijtstofelement uit een Kernreactor van Het Kokend Water Type." Johannes Asijee. 63p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12343.

18579

ON THE LINEAR EXTRAPOLATION LENGTH ON THE SURFACE OF AN INFINITE PLATE. M. Angelopoulos. Atomkernenergie 5, 217-22(1960) June. (In German)

The linear extrapolation length on the surface of an infinite plate surrounded by moderator is calculated using the multiple-collision method for the plate and a P_3-approximation for the moderator. The formulation of the problem enables the extension of the method to a higher P_{2n-1}-approximation for the moderator. The results obtained by this method are compared numerically with those given by the application of a P_{2n-1}-approximation (n = 1,2) throughout the geometry. The calculation of the flux depression in the plate is also given. (auth)

18580

APPLICATION OF THE TWO-PARAMETER DIAGRAM TO THE STUDY OF THE STABILITY OF NUCLEAR REACTORS. Augustin Blaquière. Compt. rend. 250, 3316-17 (1960) May 16. (In French)

The general method of the two-parameter diagram, which was introduced and developed previously (Compt. rend. 233, 345(1951)) is applied to closed equations which occur in the behavior of nuclear reactors. The Bethe theory appears as a result of this method. (tr-auth)

18581

PRESENT AND FUTURE DEVELOPMENT IN THE ORGANIC MODERATED REACTOR CONCEPT. L. Biondi (Montecatini S.p.A., Milan). Energia nucleare (Milan) 7, 397-406(1960) June. (In Italian)

After a historical survey of the work carried out in the organic moderated reactor field up to this time, the various problems and possibilities connected with such plants are examined and discussed. It is remarked that a reliable and convenient fuel element is not available for this type of reactor up to now and a development line from uranium oxide fuel elements cladded by stainless steel to more economic claddings such as carbon steel and SAP is indicated. The consequences of a failure in the organic-water heat exchangers are shown and some design concepts in order to reduce the importance of such an accident are described. Some considerations about safety are discussed and the problem of the transfer of the fuel elements from the core to the decay pool is particularly mentioned. (auth)

18582

LEAK CONTROL IN URANIUM FUEL ELEMENTS BY ELIQUATION WITH HELIUM. Serge Choumoff (Compagnie Française Thomson-Houston). Inds. atomiques 4, 95-103 (1960). (In French)

The principle of the control of leaks in fuel elements by a sensitive and nondestructive method such as helium eliquation is reviewed. The problems in the industrialization of a process only studied on a laboratory scale are discussed. The immersion and detection elements of an eliquation installation are described. The adjustment of such an installation with respect to the length of immersion, the signal transfer time, and the residual pressure in the eliquation vessel in order to assure the detection of helium is considered in some detail. (tr-auth)

18583

CALCULATION OF THE EPITHERMAL EFFECTIVENESS OF THE CONTROL RODS IN THERMAL REACTORS. Hideo Aisu, Shōichirō Shimada, and Masao Ueji (Mitsubishi Atomic Power Ind., Inc., [Japan]). J. Atomic Energy Soc. Japan 2, 266-75(1960) May. (In Japanese)

The average neutron transmission probability for computing the control rods' epithermal effectiveness was calculated for various control rods at normal temperatures from fundamental nuclear cross sections. The materials for which the calculations were made were Hf, Ag, In, Ag-In-Cd alloy (80 : 15 : 5 wt.%, and Eu_2O_3 (2.5, 5.0, 10.0, and 20.0 wt.%) in stainless steel. By comparing resultant values with those obtained experimentally by Bach and Way at Knolls Lab. for Hf, Ag, and In, satisfactory agreement was found if a modification for a deviation from the 1/E spectrum in the epithermal region is applied to the average transmission probability. The modification due to the reactor spectrum is quite essential. (auth)

18584

CHARACTERISTICS OF REFLECTORS. Masuhiko Otsuka (Electric Power Development Co. Ltd., [Japan]). J. Atomic Energy Soc. Japan 2, 276-84(1960) May. (In Japanese)

The concept of albedo is defined independently of cores in the two-group diffusion theory, and it consists of three reflection coefficients. The non-slowing-down reflection coefficient (β_f) represents the fraction of the fast-group neutrons entering a reflector which are reflected in the same fast group; the slowing-down reflection coefficient (β_{tf}) gives the fraction of the neutrons thermalized and reflected. For entering thermal neutrons, the thermal reflection coefficient (β_t) exists. The albedos of commonly used reflectors and other materials are calculated in the spherically symmetric case, and their characteristics are discussed. The reflecting power of H_2O is markedly different; in this case nearly half the reflected neutrons are thermal when fast-group neutrons enter the reflector. The albedo of a multi-layer reflector is also formulated. The thin Be reflector surrounded with graphite is effectively the same as the thick Be reflector. The method studied can be extended for the multi-group diffusion theory. (auth)

18585

STUDY OF TIME OSCILLATION OF NEUTRON FLUX IN A REACTOR WITH A PERIODICALLY OSCILLATING SOURCE. G. Helmis. Kernenergie 1, 929-34 (1958) Nov. (In German)

The behavior of the neutron flux distribution in the case of time-varying perturbations is very important in operation of a reactor. Usually only time variation of the total number of neutrons in a reactor is considered; the regional dependence is not treated on the basis of the fact that perturbations leave the spatial form of neutron distribution unchanged, making the locational and time dependences separable. The "value" of neutrons for the chain reaction is generally considered by means of influence functions as a function of location and energy. The transfer function is calculated which relates the periodically oscillating total reactivity of a reactor around the critical value to the resultant periodically oscillating total number of neutrons around the average value. A special case is set-up, calculated, and results discussed. (T.R.H.)

18586

HYDROGEN AS A REACTOR COOLANT. Paul N. Garay (Kaiser Engineers, [Oakland], Calif.). Nuclear Power 5, No. 51, 96-9(1960) July.

H_2 as a coolant for gas-cooled reactors has a large number of advantages over He and CO_2: twice as large heat fluxes, only $\frac{1}{3}$ of pumping power, larger power densities, reduced capital costs, no restriction like that on He, a much induced activity, and a favorable surface-volume ratio of the fuel elements. However, a number of problems will arise in the use of H_2 as a coolant. The explosion hazard is not too great, since the pressure following such an explosion is 97 psig at a H : O ratio of 2 : 1; at ratios other than 2 : 1, the pressure drops sharply. The obvious solution is an inert atmosphere within the shell, and it is expected that leakages of 0.1% or less of the system volume per day may be obtained. Another problem is the reaction of H_2 with metals, which is not so easily solved; a research program must be conducted on the compatibility of materials with H_2 in the presence of radiation. Some investigations have been made on H_2-metal reactions, and some of the results are presented. Diffusion of H_2 through the pressure vessel is a minor problem; it is insignificant at 450°F. The fuel element must be UO_2, since U reacts with H_2, and the compatibility of H_2 with various fuels and canning materials is tabulated. The possibility of CH_4 formation and carbon deposition from the reaction of graphite with H_2 is discussed and some remedies given. An outline of problems which must be solved before H_2 can be used successfully as a reactor coolant is given. (D.L.C.)

18587

SURFACE PERTURBATION THEORY. Jeffery Lewins

(Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng. 7, 481-6(1960) June.

A surface perturbation method to determine reactivities is described which has application to the removal of reflectors, the lowering of water levels in reactors, the introduction of voided beam tubes, the insertion of black control rods, etc. A first-order approximation, using the unperturbed flux in the calculations, is shown to be in error for large perturbations. However, a simple one-energy expression is devised for the shape rather than the magnitude of the reactivity curve, that successfully predicts relative effects. The method is compared with an experimental determination of the reactivity worth of the variable upper reflector of the MITR. (auth)

18588

FLAT FLUX BY NONUNIFORM MODERATION. Jack M. Ravetz and John R. Lamarsh (Cornell Univ., Ithaca, N. Y.). Nuclear Sci. and Eng. 7, 496-501(1960) June.

The production of flat thermal flux by the nonuniform distribution of the moderator is discussed within the framework of two group theory for two region reactors. Equations determining the moderator distribution are derived and a numerical solution is presented for a typical reactor system. The moderator density is found to increase with increasing distance from the center of the core. All combinations of core and reflector materials cannot be used in these flat flux systems, and the restrictions which determine allowability are discussed. In the special case of slab reactors in which the core and reflector are the same materials these systems have minimum critical mass. (auth)

18589

THE PREDICTION OF STEAM VOLUME FRACTIONS IN BOILING SYSTEMS. J. F. Marchaterre and M. Petrick (Argonne National Lab., Ill.). Nuclear Sci. and Eng. 7, 525-32(1960) June.

The results of an extensive study of the relative velocity of two-phase mixtures at ANL are presented. The parameter ranges studied are pressure 150 to 2000 psi, mixture quality 0 to 0.25, superficial liquid velocity 0.5 to 8 ft/sec, and flow channel equivalent diameters of 0.4 to 2 in. The data were correlated by means of the velocity ratio (steam velocity/liquid velocity) which was calculated from the measured steam volume fraction. The steam volume fraction measurements were made by a radiation attenuation technique and the data were obtained from both adiabatic and nonadiabatic systems. The data showed that the velocity ratio is affected primarily by pressure, mixture quality, superficial velocity, and to a lesser degree by the flow channel geometry. The data are also compared with the data of other investigators for the vertical up-flow of steam-water mixtures. Working curves for the prediction of the velocity ratio are then presented which are adequate for system analyses. The working curves are given for 150, 250, 400, and 600 psi. A method of extrapolating the data for predicting working curves in the high-pressure range is suggested. (auth)

18590

AN H_2O-D_2O MODERATED REACTOR. Norman P. Klug and P. F. Zweifel (Univ. of Michigan, Ann Arbor). Nuclear Sci. and Eng. 7, 541-4(1960) June.

Calculations are made of the infinite multiplication factor in natural uranium dioxide lattices employing mixtures of light and heavy water as a moderator. The three parameters varied in the study are the metal-to-water volume ratio, pin diameter, and light-to-heavy water atomic ratio. Maxima in plots of K_∞ vs hydrogen-to-deuterium ratio indicated that such $H_2O + D_2O$ mixtures would prove advantageous in certain cases. However, in these cases, slight fuel enrichment might be required. (auth)

18591

STUDY OF THE NEUTRON FLUX CREATED BY THE INTRODUCTION OF IGNITION NEUTRONS IN A PURE MULTIPLYING MEDIUM. Ahmed Yüksel Özemre (Fakültesi Teorik Fizik Enstitüsü, Istanbul). Nukleonik 2, 100-105(1960) May. (In German)

The behavior of the neutron flux created by the introduction of neutrons in a pure multiplying medium was studied within the framework of the scattering theories with one and with several groups. In the first part of the article where the monoenergetic scattering of neutrons is discussed, the contribution of delayed neutrons in the neutron balance is also considered. (tr-auth)

18592

FLUIDIZED SOLIDS AS A NUCLEAR FUEL FOR ROCKET PROPULSION. L. P. Hatch, W. H. Regan, and J. R. Powell (Brookhaven National Lab., Upton, N. Y.). Presented at the ARS Semi-Annual Meeting, Los Angeles, California, May 9-12, 1960. New York, American Rocket Society, 1960. 5p.

Among the foremost problems to be faced in the application of fission energy to rocket propulsion is to provide for the transfer of heat, at the extremely high fluxes required, from the nuclear fuel to the low molecular weight propellant gas. For the conventional solid fuel element reactor, the necessity for very large heat transfer surface and for maintaining physical integrity of the fuel element assembly, under the extreme temperatures and temperature gradients, present most serious design and fabrication problems. The use of solid fuel in the particulate form would fulfill the needs for large heat transfer surface and greatly reduce the requirements for structural integrity. Essential features of a reactor system are outlined in which the particulate fuel is in the form of a rotating annular bed fluidized by the incoming propellant gas and restrained in the core by virtue of the centrifugal force. (auth)

18593

MEASUREMENTS OF PARAMETERS LEADING TO p_{28}, f, AND ϵ IN LIGHT WATER MODERATED 4.48% AND 2.73% ENRICHED LATTICES. Victor E. Grob (Westinghouse Reactor Evaluation Center, Rufsdale, Penna.); E. Santandrea (Fiat-Sezione Energia Nucleare, Turin); and Hilmar Ritz (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nuclear Sci. and Eng. 7, 514-524(1960) June.

As part of the Yankee and the Belgian Reactor-3 Critical Experiments program, measurements were made of the parameters leading to p, f, and ϵ in a light-water moderated heterogeneous reactor with slightly enriched UO_2 fuel rods clad in stainless steel. Measurements were made using 4.48 and 2.73% enriched fuel with lattice pitches of 0.470 and 0.435 in. The individual UO_2 sintered pellets, in the fuel rods, had a diameter of 0.300 in. and a length of 0.600 in. The 4.48 and 2.73% fuel rods contained 90 and 80 pellets, respectively. The stainless steel cladding was 0.305 in. ID and 0.347 in. OD for the 4.48% enriched fuel, and 0.306 in. ID and 0.338 in. OD in the case of 2.73% enrichment. The measurements were performed using a higher fuel enrichment than used previously at Bettis and elsewhere for similar experiments, thus uncovering a large unexplored range of enrichments (auth)

18594
Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.
ESTUDIO EXPERIMENTAL DE LA RELACIÓN DE NORDHEIM. Informe No. 20. (Experimental Study of the Nordheim Relation. Report No. 20). Juan A. Chamero. 1959. 13p.

A usual method for the measurement of the reactivity variation caused by the removal of a poison from a reactor in the critical state consists in measuring the stable period of increase of the neutron flux and using the Nordheim relation. It is also possible in a subcritical reactor to compare one reactivity with another by measuring the neutron flux levels prior to the introduction of each reactivity. The results obtained by both methods are compared. It is verified that by placing a poison at a certain point of the core, a value dk is obtained measured by the stable period. Adding to the subcritical reactor poisons equal to the master poison symmetrical with respect to the center of the core charge and comparing the reactivities proves that within certain limits there is additivity of the reactivities. In a second experiment these poisons were extracted in multiples in a critical regime, and the stable periods resulting from the extractions were measured. These experimental periods were compared with those obtained from the Nordheim relation. Within the errors of the method, agreement was obtained between the measured and calculated periods. (tr-auth)

Power Reactors

18595 ACNP-ERR-6
Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.
ELK RIVER REACTOR QUARTERLY PROJECT REPORT [FOR] SEPTEMBER–OCTOBER–NOVEMBER 1959. 15p. Contract AT(11-1)-654. OTS.

With the project design work virtually complete, progress during the quarter consisted primarily of procurement, fabrication of components, and construction at the reactor site. Developments are briefly summarized in the fuel element program, core physics vessel and internal components, control rods and rod drives, shielding, process, instrumentation, building and facilities, and construction. (For preceding period see ACNP-ERR-5.) (W.D.M.)

18596 AECL-990(Paper 2)
Atomic Energy of Canada Ltd., Chalk River, Ont.
POWER-REACTOR FUNDAMENTALS. G. A. Pon. Paper 2 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 8p.

Various components of heterogeneous thermal reactors are discussed, and some details of heavy water moderated reactors are given. The NRU Reactor is briefly described. (W.D.M.)

18597 AECL-990(Paper 9)
Canadian General Electric Co., Ltd. Civilian Atomic Power Dept., Peterborough, Ont.
ENGINEERING THE NPD-2 POWER PLANT. I. N. MacKay. Paper 9 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 8p.

The NPD-2 power plant is described briefly, and some areas where satisfactory solutions to knotty design problems were evolved are discussed. (W.D.M.)

18598 AECL-990(Paper 10)
Canadian General Electric Co., Ltd. Civilian Atomic Power Dept., Peterborough, Ont.
THE NPD-2 CALANDRIA. W. M. Brown. Paper 10 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 15p.

The engineering aspects of the NPD-2 calandria are discussed. The calandria is a horizontal cylinder-like vessel with double side and end walls. It has an over-all depth of roughly 19 ft. and an over-all length of 15 ft. The average thickness of the light water reflector-shield between inner and outer side and end walls is about 14 inches. The entire calandria is constructed of aluminum alloy and has a dry weight of approximately 20 tons. (W.D.M.)

18599 AECL-990(Paper 14)
Atomic Energy of Canada Ltd., Chalk River, Ont.
FUEL FOR POWER REACTORS. A. J. Mooradian. Paper 14 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 16p.

The ultimate objective of the fuel program for Canadian power reactors is to evolve a fuel that will contribute less than 1.0 mil/kwh to the cost of power. An outline is given of the basis on which the major fuel parameters such as materials and shape are decided. Design is discussed in detail, and direct reference is made to manufacturing problems. (W.D.M.)

18600 AECL-990(Paper 15)
Ontario. Hydro-electric Power Commission, Toronto and Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto.
THE DOUGLAS POINT PROJECT. D. L. S. Bate. Paper 15 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 6p.

The Douglas Point Project is a 200-Mw nuclear generating station to be constructed on the shore of Lake Huron about 10 miles north of Kincardine. It will consist initially of a single reactor (CANDU) and a single turbine-generator together with associated auxiliary plant. The plant arrangements as the design now stands are reviewed briefly, and the location and function of the components are described. (W.D.M.)

18601 AECL-990(Paper 16)
Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto.
COMPONENTS FOR THE DOUGLAS POINT REACTOR. P. H. G. Spray. Paper 16 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 10p.

A brief description is given of some of the more important components of the CANDU Reactor including calandria dump tank, end shields, end fittings, thermal shields, vault lining, boilers, steel dome, dousing tank, moderator heat exchanger, and fueling machines. (W.D.M.)

18602 AEPSC-608
American Electric Power Service Corp., New York.
PROTOTYPE POWER PLANT GAS-COOLED REACTOR PROJECT. Progress Report No. 2 from March 15, 1959 to

September 30, 1959. Oct. 15, 1959. 175p. For East Central Nuclear Group and Florida West Coast Nuclear Group, Inc. Contract AT(38-1)-200. OTS.

The major effort during the period was directed toward the development of the reference design. The program of cycle analyses culminated in the selection of a single-pressure reheat cycle having a thermal performance comparable to conventional plants. Containment proceeded concurrently with plant layout studies and resulted in the selection of a vertical steel cylinder designed to enclose the reactor CO_2 coolant system. A number of possible accidents, ranging in degree from the least to the most severe, were postulated and calculational procedures developed to determine the resultant post-accident containment conditions. A tentative construction and testing sequence for the containment was prepared. Studies were continued on the economic feasibility of an excavated versus a piled plant, and the final decision was made in favor of top versus bottom refueling. A preliminary cost estimate of the reference design was prepared. Hazards evaluation studies indicated that there is every assurance that operation of the plant will not seriously endanger the health and safety of the general public. (W.D.M.)

18603 AFSWC-TN-60-9
Air Force Special Weapons Center, Kirtland AFB, N. Mex.
AN INTRODUCTION TO NUCLEAR PROPULSION.
Kenneth R. Chapman. Apr. 1960. 51p. Project No. 7812.

Rocket propulsion by nuclear fission energy is discussed in nonscientific terms. A single parameter (specific impulse) is used in comparing propulsion schemes of nuclear and chemical rocket engines. Various means of using nuclear energy for rocket propulsion are described. Propulsion requirements for three selected missions are discussed. (C.J.G.)

18604 APAE-55
Alco Products, Inc., Schenectady, N. Y.
SM-1 REACTOR CORE INSPECTION AT 2/3 CORE LIFE. [Period covered] March 7, 1959 to May 17, 1959. B. J. Byrne, T. F. Connolly, D. D. Foley, R. V. Lichtenberger, S. D. Mackay, J. H. Morrison, R. D. Robertson, S. S. Rosen, R. S. Stein, D. C. Tubbs, G. J. Vodapivc, and H. J. Weil—C. H. Obrist, comp. Jan. 13, 1960. 171p. Contract AT(30-3)-326. OTS.

The SM-1 reactor vessel head was removed and the core inspected at $^2/_3$ core life in order to obtain irradiation data from studies of the boron fuel elements and absorber sections. Selected high burnup boron elements from Core I were replaced by Core II europium elements. Studies of the elements removed were conducted both on the site and at ORNL. In on-site examinations, definite cracks were observed on two of the absorbers, and a number of other possible cracks were noted. Maximum expansion of the absorbers varied from 0.020 to 0.045 in. Discoloration and possible pitting were noted in the fuel elements, and a number of possible cracks in side plates and fuel plates were opened. Subsequent detailed examination at ORNL verified the occurrence of cracks and measured maximum absorber growth at 0.010 to 0.070 in. The possible cracks noted in the fuel elements in the periscopic examination were found at ORNL to be scratches containing dark deposits. Results of the core examination indicated that the boron control rod elements were not satisfactory for full core life. All boron absorbers were replaced with europium oxide absorbers. (M.C.G.)

18605 APAE-Memo-179 & Suppl. 1 & 2.
Alco Products, Inc., Schenectady, N. Y.
SM-2 VAULT CRITICALITY. B. E. Fried. Feb. 27, 1959. (Includes Suppl. 1, Apr. 3, 1959; Suppl. 2, Apr. 22, 1959). 27p. Contract AT(30-3)-326. OTS.

To determine the safety of the array in the storage vault for the SM-2 experimental fuel plates, two criticality criteria were applied. A maximum of 18 fuel plates was stored in stainless steel tubes and the tubes bolted to a frame on the wall to prevent movement. No tube could go critical by itself. The vault was then assumed completely flooded by water. In the first calculation, the fuel array was assumed to be distributed uniformly over the wall forming a large slab. This method indicated the array might be critical if the steel tube and cadmium lining were neglected. In the second method, a conservative calculation, which included the steel tube and cadmium lining, was made. This method indicated the array was subcritical. Calculations were then made of the criticality of the SM-2 vault without the steel—cadmium tubes and wooden blocks. The multiplication factor of the vault was also calculated. In order to determine the accuracy of these calculations, an ORNL critical experimental array was calculated applying the same analytical techniques. (M.C.G.)

18606 APAE-Memo-254
Alco Products, Inc., Schenectady, N. Y.
SM-1 REACTOR VESSEL PENETRATED GASKET DESIGN AND TEST REPORT. F. G. Gebhardt. June 10, 1960. 56p. Contract AT(30-3)-326. OTS.

Mechanical compression tests were performed on gasket test specimens machined to the cross-sectional dimensions of a stainless steel (Type 304) ring type gasket to be installed in the SM-1 reactor pressure vessel. Testing the mechanical properties of the gasket specimens under varying loads, and subsequent sectioning and inspection of specimens for adequacy of welded and brazed joints, gave the following results: (1) a penetration scheme involving five 0.070-in. diam. holes, spaced $^1/_4$ in. center-to-center for each $6^1/_2$ in. bolt circle span, may be made in a gasket ring without materially increasing the gasket stresses, (2) a lug may be welded to the gasket face to provide a brazed sealing support for 0.0625-in. diam. tubes and thermocouples, and (3) excellent attachments can be made by tungsten-inert gas welding of the lug to the gasket face and induction brazing of the tubes and thermocouples to the lug using Nicrobraz alloy. (auth)

18607 APAE-Memo-260
Alco Products, Inc., Schenectady, N. Y.
SPECIFICATIONS AND FABRICATION PROCEDURES FOR PM-2A CORE II CONTROL ROD FUEL ELEMENTS. May 13, 1960. 94p. Contract AT(30-3)-326. OTS.

Specifications were prepared for control rod fuel elements for the Core II of PM-2A. These stainless steel-base fuel components of thin plate-type construction and containing a dispersion of UO_2 were successfully used in powering the Army Package Power Reactor. The component, which consisted of sixteen composite fuel plates joined by brazing, was designed for radioactive service in pressurized water. Tests for qualification of fabrication procedures and specifications covering loading, materials, and processing are presented. Also included are drawings and the process flow diagram. (M.C.G.)

18608 APAE-Memo-261
Alco Products, Inc., Schenectady, N. Y.
SPECIFICATIONS AND FABRICATION PROCEDURES FOR PM-2A CORE II STATIONARY FUEL ELEMENTS. May 13, 1960. 100p. Contract AT(30-3)-326. OTS.

Specifications were prepared for stationary fuel

elements for PM-2A Core II. Stainless steel-base fuel components of thin plate-type construction and containing a dispersion of UO_2 were successfully used in the Army Reactor (SM-1). The component consisted of eighteen composite fuel plates joined by brazing, and was designed for radioactive service in pressurized water. Fabrication qualification tests and specifications covering loading, materials, and processing are presented. Also included are applicable drawings and the process flow diagram. (M.C.G.)

18609 APAE-Memo-262

Alco Products, Inc., Schenectady, N. Y.

SPECIFICATIONS AND FABRICATION PROCEDURES FOR PM-2A CORE II NEUTRON ABSORBER SECTIONS. May 13, 1960. 59p. Contract AT(30-3)-326. OTS.

Specifications were prepared for the control rod absorber sections for Core II of Army Reactor PM-2A. The neutron absorber section was composed of composite plates welded into the form of a rectangular parallelepiped. The composite plates were made of compacts of europium oxide in a stainless steel matrix clad with stainless steel by hot-roll bonding. Specifications covering materials and processes are included in the report along with fabrication qualification tests. (M.C.G.)

18610 APEX-410

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

CLOSED-CYCLE GAS-TURBINE NUCLEAR POWER PLANTS. T. Szekely. Feb. 1957. Decl. Jan. 19, 1960. 60p. Contracts AF33(038)-21102 and AT(11-1)-171. OTS.

A general discussion is presented on the technology of closed-gas-cycle nuclear power plants. Included are treatments of the fundamentals, cycle of operation, advantages, design considerations involving the reactor as the heat source, methods of thermodynamic analysis, fuel element design considerations, breeder design considerations, controls design, and considerations involving the selection of a gas working fluid and the operating pressure level. (auth)

18611 BAW-106-1

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

TRANSIENT FLOW PERFORMANCE IN A MULTI-LOOP NUCLEAR REACTOR SYSTEM. George M. Boyd, Jr., Ralph M. Rosser, and Bennett B. Cardwell, Jr. Dec. 1959. 33p. OTS.

Presented at the 1959 Winter Meeting, American Nuclear Society, November 4-6, 1959, Washington, D. C.

A method for determining coolant flow and pump speed for various transient conditions in a reactor is described. The transient conditions considered include those due to power failure, starting pumps in idle loops, and the opening of an active pump's discharge valve. Parallel pumps in a system may be analyzed independently of each other. Examples are presented in calculations on the N. S. Savannah and Indian Point Power Reactors. The retardation torque resulting from loss of power to canned rotor pumps was found to be significant. The worst cold water accident (sudden insertion of a large quantity of cold water to core) was found to result when pumps in a cold loop are started while the stop valves are wide open. (C.J.G.)

18612 BAW-1176

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

NUCLEAR MERCHANT SHIP REACTOR CONTROL ROD DRIVELINE TESTS. D. E. Thoren and D. K. Gestson. Nov. 1959. 118p. Contract AT(30-3)-274. OTS.

Tests were conducted to determine the performance of the various components of a control-rod driveline, prototype of the one to be installed in NS Savannah. Tests to evaluate the design, materials, and fabrication methods of the entire assembly included stroking the drive a total of 32,000 ft and 350 scrams, or about 70% of design life. Operating characteristics and requirements were determined. Scram time for $\frac{2}{3}$ insertion was less than 0.807 sec, and a maximum driveline velocity of about 10 sec was realized for these conditions. The snubber force was capable of absorbing the scram forces associated with a maximum deceleration of 3.5 g's. The hydraulic circuit functioned reliably under recommended shipboard installation procedures. During 400 actuations, the safety latches demonstrated that they could lock the drivelines under the most severe conditions of maximum main loop pressure. Control-follower rod wear, indicated by marks on the blade surface, was not measurable. The simulated reactor internals forming the control-rod channel experienced negligible wear. These tests and others demonstrated that the control-rod driveline met the design requirements and should function reliably for extended periods. (M.C.G.)

18613 BNL-297

Brookhaven National Lab., Upton, N. Y.

QUARTERLY PROGRESS REPORT [FOR] FEBRUARY 16–MAY 15, 1954. Decl. Apr. 8, 1957. 48p. OTS.

Buckling measurements with 0.600-in. fuel rods in clean water were completed for U enrichments of 1.3, 1.15, and 1.0%. Water-to-U volume ratios of 1, 1.5, 2, 3, and 4 to 1 were used. Values of $B^2 = +0.26 \pm 19 \times 10^{-4}/cm^2$ and $k = 1.0009 \pm 0.0006$ were obtained from a lattice of natural U rods in H_2O at a volume ratio of 1.5:1. A proposed shim control system for the LMFR is described which will maintain continuous control of the fuel concentration. In a test of the "torch" process for removing Pa and U from ThF_4 blankets by the fluorination of contaminants in a H_2-F_2 flame, 77% of the original feed lost 72% of its original activity. A method using fused salts was less successful. It was found that 92 to 95% of mixed fission product activity in molten $NaNO_3$ was scavenged out by a suspension of metallic oxides such as Mn and Fe. Isothermal studies of Th_3Bi_5 in liquid Bi and a liquid Pb–Bi eutectic showed that after 2000 hr, the compound particles grow larger in Bi, but thermal cycling tests with the same dispersions indicated that the particles grow larger in Pb–Bi. Static corrosion tests of B and W alloy 701 and chromized Croloy $2\frac{1}{4}$ showed no corrosion in Bi or U–Bi. Wetting experiments revealed that pure Fe can be wetted by heating to 1600°F under high vacuum and immersing in Bi at 725°C for 5 hr. Additional data are presented on the erosion of graphite by Th–Bi, the solubility of Fe and Zr in Bi, the adsorption of Zr on Fe from liquid Bi, the radiation damage of SiO_2, and the thermal cycling of U. The transmission of neutrons through an air slot was investigated as a function of slot dimensions. Parameters of several neutron resonance levels in U^{238} were obtained. (For preceding period see BNL-285.) (C.J.G.)

18614 CEND-70

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

ABWR PL-1 REFERENCE DESIGN REPORT. F. J. Staron and L. M. Johnson. Jan. 15, 1960. 121p. Contract AT(10-1)-967. (IDO-19007). OTS.

The reference design of a Portable Boiling Water Reactor Plant with a net electric output of up to 250 kw and a net space heat output of 400 kw is presented. The total reactor

thermal power is 3.6 Mw, and the design life of the core is 8 full power years. The principle objectives which have governed the reference design are: (1) the plant shall be air transportable by C-130A aircraft; (2) the plant shall be designed for minimum installed cost consistent with a maximum degree of reliability; and (3) the plant shall be designed for minimum down time. This design is a development of the SL-1 Prototype which has operated successfully for more than one year. Automatic reactor pressure control by rod motion, direct air condensing with air recirculation, and the use of condensate for auxiliary coolant are concepts which have been successfully demonstrated at the prototype facility. (auth)

18615 CEND-82

Combustion Engineering, Inc. Nuclear Div., Idaho Falls, Idaho.

SL-1 ANNUAL OPERATING REPORT [FOR] FEBRUARY 1959—FEBRUARY 1960. R. T. Canfield, J. S. Crudele, E. J. Vallario, R. G. Young, and W. P. Rausch. May 1, 1960. 107p. Contract AT(10-1)-967. (IDO-19012). OTS.

The period from February, 1959, when CE assumed operative responsibility of the SL-1 Reactor Plant, to February, 1960 is covered. The operations of the year are summarized; the reactor, instrumentation, mechanical, electrical, and facility systems are evaluated; health and safety, and the operational costing program are discussed. (auth)

18616 CF-57-4-27(Rev.)(Del.)

Oak Ridge National Lab., Tenn.

A PRELIMINARY STUDY OF MOLTEN SALT POWER REACTORS. H. G. MacPherson, L. G. Alexander, D. A. Carrison, J. Y. Estabrook, B. W. Kinyon, L. A. Mann, J. T. Roberts, F. E. Romie, and F. C. VonderLage. Apr. 29, 1957. Decl. with deletions Nov. 20, 1957. 143p. Contract W-7405-eng-26. OTS.

A preliminary study of molten salt power reactors was made. The most promising fuel carrier salts were the fluorides and chlorides of the alkali metals, zirconium, and beryllium. The chlorides were found to have lower melting points but were less stable and more corrosive than the fluorides. A Li^7F-BeF_2 mixture with ThF_4 and UF_4 appeared to perform best. Of the numerous alloys tested as container material, Inconel and a nickel—molybdenum alloy INOR-8 appeared to be the most resistant to corrosion. To study the performance, safety, economics, and construction costs of a typical molten salt reactor, a reactor of specific type and size was chosen for study. The reference design reactor was a two-region homogeneous converter with a core salt of 70 mole % Li^7F and 30% BeF_2. ThF_4 and enough VF_4 for criticality were added. Study indicated that a molten salt reactor would produce economical power, but the problem of developing a salt core and a container metal which would last for many years of operation needed further study. (M.C.G.)

18617 CF-58-10-60

Oak Ridge National Lab., Tenn.

SURVEY OF LOW ENRICHMENT MOLTEN-SALT REACTORS. H. G. MacPherson. Oct. 17, 1958. 8p. OTS.

A rough survey of the nuclear characteristics of graphite-moderated molten-salt reactors utilizing an initial complement of low enrichment uranium fuel has been made. Reactors can be constructed with initial enrichments as low as 1.25% U-235; initial conversion ratios of as high as 0.8 can be obtained with enrichment of less than 2%. Highly enriched uranium would be added as make-up fuel, and such reactors could probably be operated for burnups as high as 60,000 Mwd/ton before buildup of fission products would make replacement of the fuel desirable. A typical circulating fuel reactor of this class might contain an initial inventory of 3600 tons of 1.8% enriched uranium, operated at 640 Mw (thermal), and generate a net of 260 Mw (electrical). The total fuel cycle cost would be approximately 1.3 mills/kwhr, of which 1.0 mill is burnup of enriched U-235. (auth)

18618 CF-59-7-88

Oak Ridge National Lab., Tenn.

A PARAMETRIC STUDY OF A GAS COOLED REACTOR. L. G. Epel. July 24, 1959. 25p. Contract W-7405-eng-26. OTS.

The results of a parametric study on a gas cooled reactor are reported. The system considered was a helium-cooled, UO_2-fueled arrangement with fuel assemblies consisting of clusters of long cylindrical elements, each element covered by a stainless steel jacket. The axial power distribution was assumed to be a "chopped cosine" having an axial peak-to-average power of 1.32. The three parameters of interest in the study were the diameter of coolant channel, pressure drop through core, and pumping power expended. The analysis is presented for the central channel. (auth)

18619 CVNA-47

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

ANALYSIS OF REACTIVITY ACCIDENTS AND OF CHANGE IN LOAD TRANSIENTS FOR THE CVTR REACTOR. D. E. Rathbone and H. H. Norman. Feb. 1960. 68p. OTS.

Results of analog computer investigations of reactivity accidents and of change of load studies for the CVTR reactor are presented. The reactivity accidents discussed are the start-up accident from source level, the rod withdrawal at power accident, the hot and cold water accidents, and the xenon poisoning accident. The change of load studies include both step increase and step decrease load perturbations. For many of the studies, both parameter and analogue computer model variations were investigated. The severest accident, and thus the limiting case, was the rod withdrawal at power with a reactivity insertion of 12×10^{-4} δk/sec. The high-power level scram prevented any core damage. In light of the conservative assumptions employed in all phases of the studies, the results indicate a safe reactor for the accidents studied. (auth)

18620 DP-480

Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.; Nuclear Development Corp. of America, White Plains, N. Y.; and Sargent and Lundy, Chicago.

HEAVY-WATER-MODERATED POWER REACTORS. A Status Report. D. F. Babcock, P. J. Davis, R. R. Hood, and G. F. Hoveke. Mar. 1960. 54p. Contract AT(30-1)-2303(IX). OTS.

Cost estimates show that a pressure tube reactor cooled by boiling D_2O offers the most promise of eventually producing competitive electric power of any of the various D_2O-cooled-and-moderated reactor systems that have been studied to date. It is estimated that a boiling reactor fueled with natural uranium could produce power for about 9 mills/kwh in a 300 Mw(e) plant and for about 10 mills/kwh in a 200 Mw(e) plant. In order to attain completely competitive power costs, the fuel cycle cost must be made lower than the cost of either fossil fuel or the enriched uranium fuel used in other types of power reactors. It is concluded that first priority should be given to development work aimed at determining whether the fuel cycle cost in a full-scale reactor can be reduced to 1 mill/kwh, and pref-

erably to an even lower value. The early portion of this work can be accomplished in the Heavy Water Components Test Reactor (HWCTR), a fuel-irradiation facility now under construction. (auth)

18621 DP-495

Du Pont de Nemours (E. I.) & Co. Explosives Dept., Wilmington, Del.

HEAVY WATER MODERATED POWER REACTORS PROGRESS REPORT, APRIL 1960. R. R. Hood and L. Isakoff, comps. May 1960. 38p. Contract AT(07-2)-1. OTS.

Safeguards analyses of the isolated coolant loops of the HWCTR indicated that accidental loss of cooling water from the loop heat exchangers will not lead to vapor binding of the loop D_2O pumps, or to other detrimental consequences, providing that the reactor is scrammed following the loss of coolant. Several static seals of the types that will be used in the HWCTR exhibited leakage rates that were well below design specifications during cyclic tests at peak conditions of 1500 psi and 260°C. From full-scale experiments with lattices of seven-rod clusters of natural uranium metal at various lattice spacings in D_2O, values for the bucklings, flux distributions, and microscopic parameters of the lattices were measured. (For preceding report see DP-480.) (auth)

18622 IDO-19014(Vol. I)

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

HEALTH PHYSICS AND RADIOCHEMISTRY MANUAL FOR ARMY NUCLEAR POWER PLANTS. VOLUME I. BASIC CRITERIA. Reynold L. Hoover, Ernest T. Borawski, Gerald S. Golden, Robert L. Hancock, and Robert L. Layfield. [1960]. Changed from OFFICIAL USE ONLY June 6, 1960. 125p. Contract AT(10-1)-967. OTS.

The basic criteria for health physics, radiochemistry, and environmental monitoring for boiling water, pressurized water, and gas cooled reactors is presented. The requirements for radiation measurements in all of the above mentioned areas are integrated with respect to human engineering. Emphasis is placed on operational philosophy, basic requirements, and evaluation of data. The material is compiled and correlated to standardize operational power plant requirements by inter-relating health physics, environmental monitoring, and a radiochemistry program. (auth)

18623 IDO-28539

Aerojet-General Nucleonics, San Ramon, Calif.

ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM—IN-PILE LOOP TESTS OF GCRE ELEMENTS (I-1T AND I-1'T). S. Nakazato, P. M. Williams, and W. D. Wilson. July 2, 1959. 79p. Contract AT(10-1)-880. OTS.

In-pile loop experiments were conducted to test the behavior of the reference GCRE-I fuel element. The tests were made in the BRR-GCR loop located adjacent to the Battelle Research Reactor (BRR) core. The I-1T was exposed for 1180 hr in the reactor with an average power output of 13 kw in an average neutron flux of 2.7×10^{12} n/cm^2-sec. The major conclusions from the I-1T are: (1) no major geometrical change occurred during the test; (2) the heat transfer coefficients calculated from the data average 12.5% higher than those calculated from the Modified Colburn equation; (3) the heat transfer calculation method used for the GCRE-I fuel element temperature prediction is accurate within the uncertainty of the experimental results; and (4) no evidence of surface erosion was observed on the plates due to vibration of the clips. The I-1'T test was subsequently conducted to test the behavior of the reference GCRE-I fuel element under severe thermal-cycling conditions. During an irradiation time of 393 hr, the element was thermally cycled 502 times between 1600 and 700°F by varying the flow rate. The element heat output was 12 kw. There were some minor changes in dimensions of the gas annuli, but no major distortion occurred. (auth)

18624 MND-MPR-1581(Vol.II)

Martin Co. Nuclear Div., Baltimore.

[MARTIN DESIGN REPORT—ICE CAP NUCLEAR POWER PLANT. VOLUME II]. Includes Appendix A: SYSTEM DESIGN DATA ON WHICH ANALYSIS WAS BASED. [1959]. 14p., 9 illus.

Drawings of the Martin Package Reactor components are presented. A section is included in which a brief description of the basic system design data is given. (J.R.D.)

18625 MTA-34(Del.)

California Research and Development Co. Livermore Research Lab., Livermore.

INITIAL REPORT ON NUCLEAR POWER PLANT ECONOMICS. May 15, 1953. Decl. with deletions Sept. 23, 1959. 51p. Contract AT(11-1)-74. OTS.

An appraisal was made of the economic position of power from nuclear reactors in competition with conventional power plants. Long range aspects of the problem were of primary interest, and the analysis was based on a future period with technology of nuclear plants assumed far enough advanced to justify the investment of private capital. A tentative selection of "ground rules" for economic evaluation was made, and their application to proposals for production of electrical power was reported. An attempt was made to adjust the technical and cost aspects to a basis permitting consistent evaluation. The computed power costs for the nuclear plant concepts considered, ranging from 6.5 to 14.1 mills/kwh, were close to the figure of 6.7 mills/kwh for a modern conventional plant adopted as a standard. (M.C.G.)

18626 NAA-SR-4532

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

HEATING TRANSFORMER PERFORMANCE. R. S. Baker and I. Villalva. June 30, 1960. 24p. Contract AT-11-1-GEN-8. OTS.

A heating transformer was tested for suitability in preheating large piping systems for sodium service. Power was supplied to the pipe by connecting the secondary winding of the transformer to the pipe, current thus being passed through the pipe walls. The primary winding is connected to a single-phase, 60-cycle power source. The test system consisted of a 75-ft-long closed loop of 12-in., Schedule 20, Type 304 stainless steel pipe, thermally insulated. A power input of 6200 watts raised the pipe temperature from 70 to 272°F in 8 hr. Around the loop, temperatures were uniform, the highest being 272°F; while the lowest was 250°F. Heating efficiency was 90%; power factor, 55%. Results of measurements of the transformer output compared favorably with the calculated values. Design calculations for the transformer are presented. (auth)

18627 NAA-SR-4576

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PIQUA OMR WASTE GAS DISPOSAL. H. M. Gilroy and J. H. Wilson. July 15, 1960. 67p. Contract AT-11-1-GEN-8. OTS.

The Piqua OMR (Organic Moderated Reactor) required

processes to prevent atmospheric contamination from both radioactive and organic materials released during reactor operation. To develop suitable processes a Waste Gas Treatment Development Program, based on Piqua design and operation, was established. Bench scale development work on adsorption of organic vapors and water scrubbing of simulated waste gas demonstrated the feasibility of these methods for removing organic materials from waste gas streams. Conventional air filters were demonstrated to be successful in the removal of organic coolant dusts from air streams. Extraction of radioactivity from organic coolant into process water streams was investigated and reduction of water activity to safe limits by centrifugation and ion exchange was demonstrated. Based on this development work a full scale Waste Gas Treatment Prototype, consisting of a combined gas and water treatment system, was designed, constructed, and operated in conjunction with other Piqua OMR process prototype systems. Waste Gas Treatment Prototype operation has supplied design information and operating data for Piqua OMR design and operation. (auth)

18628 NAA-SR-5077
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
OMR (PIQUA) UNITIZED CONTROL-SAFETY ROD PROTOTYPE TESTS. J. D. Howell and C. C. Weeks. June 30, 1960. 55p. Contract AT-11-1-GEN-8. OTS.

A unitized magnetic jack driven control-safety rod was developed for the 45.5 thermal megawatt organic moderated reactor (Piqua). The rod assembly, including neutron absorber, magnetic jack drive, shock absorber and position indicator, is designed to be installed inside the reactor core tank and to operate immersed in the reactor coolant (Santowax-R) at 550 to 600°F. Results of component tests were reported in NAA-SR-3172. Two prototype rods, representative of the type to be used in the Piqua plant, were subjected to extensive performance and life tests in hot Santowax-R. Requirements on rod speed (10 inches per minute) scram time (800 microseconds maximum) and position indicator accuracy (±¼ inch) were met in these tests. Total rod travel without failure or maintenance of 86,000 and 65,000 feet, respectively, (equivalent to 10,750 and 8,125 full excursions) by the two prototypes demonstrated the reliability of the magnetic jack drive in this application. (auth)

18629 NAA-SR-5313
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
DEVELOPMENT OF TEMPERATURE PROTECTIVE CIRCUITS FOR THE HNPF FUEL CHANNEL EXIT. D. E. Brown. June 30, 1960. 18p. Contract AT-11-1-GEN-8. OTS.

The HNPF plant protective system includes circuits with the function of precluding unsafe high temperature and sustained fast changes in fuel-channel coolant-exit temperatures, either in the increasing or decreasing direction. The development of the fuel-channel exit high temperature and rate change of temperature circuits resulted in a transistorized system of plug-in components of high reliability. The circuits were designed, where possible, for fail-safe operation in case of component malfunction; and for ease of maintenance and calibration. In addition to providing shutdown or scram signals, these circuits also provide setback and alarm signals. The setpoints for scram, setback, and alarm are each independently adjustable. These circuits monitor an iron-constantan thermocouple located at the outlet of a fuel cluster in the reactor. In the actual protective system, three identical circuits are used in a 2-out-of-3 coincidence arrangement to enhance the over-all reliability. (auth)

18630 NAA-SR-Memo-2201
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
MAINTENANCE PROCEDURE FOR SRE MAIN PRIMARY SODIUM PUMP. H. Strahl and H. Chapman. Oct. 16, 1957. 11p. OTS.

A study was conducted to obtain information to be used as a basis for recommending cleaning and maintenance procedures for the SRE main primary sodium pump. Results and recommendations are summarized. (J.R.D.)

18631 NAA-SR-Memo-3522
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
EXPANDED SCALE TEMPERATURE RECORDER. R. W. Madsen. Jan. 26, 1959. 4p. OTS.

The design and performance of an expanded-scale temperature indicator-recorder for measuring the fuel channel outlet temperatures in the SRE are discussed. The resistance thermometer contains two scales, scale No. 1 is standard 0 to 1200°F and scale No. 2 is an expanded scale, 0 to 100°F full scale covering the range 800 to 1000°F. (C.J.G.)

18632 NAA-SR-Memo-3654
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
RADIOLOGICAL HAZARDS OF CALANDRIA CORE REMOVAL. W. P. Kunkel. Mar. 16, 1959. 12p. OTS.

The calandria design for the SRE core was conceived to provide an alternate core for continued experimental programs. It was designed for fabrication outside the radioactive area and installation as a unit. This integral type of construction could create a problem of removal. Therefore, investigation of the radiation hazards of calandria core removal after five years of operation in the SRE at full power was carried out. Activation of calandria components was computed at 20 Mw. Dose rates were estimated for several conditions, and recommendations for shielding were made. Disposal of the radioactive wastes was also considered. (M.C.G.)

18633 NAA-SR-Memo-3760
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
SRE-EDISON PLANT CONTROL SYSTEM. R. J. Hall, E. D. Bilbao, and E. Young. Apr. 14, 1959. 28p. OTS.

The design of the control system for the steam plant to be used with the SRE is given. Operation of the system is discussed. (C.J.G.)

18634 NAA-SR-Memo-3844
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
TELEVISION MONITOR—SRE FUEL COFFIN. D. K. Darley and J. D. Smith. May 6, 1959. 7p. OTS.

The successful employment of a closed circuit television system to view fuel as it enters the SRE fuel coffin is reported. The camera was mounted in a modified index ring equipped with a viewing port. (C.J.G.)

18635 NAA-SR-Memo-4514
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
EVALUATION OF HNPF MARK B DRIVE. P. F. Shaw. Oct. 13, 1959. 15p. OTS.

Acceleration of the Hallam Power Reactor Mark B drive from zero to approximately 98% of maximum speed re-

quired from 0.126 to 0.267 sec. Deceleration of the control rod drive from full speed to zero varied from 0.061 to 0.073 sec using the magnetic brake. Full speed of the motor was determined for 54 rpm change gears and 22.6 rpm gears. A procedure for assembly of the motor is contained. (C.J.G.)

18636 NAA-SR-Memo-4952
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
STUDY OF FUEL TEMPERATURE AND FLOW EFFECTS OF PLUGGING IN SRE FUEL CHANNELS. R. C. Noyes. Mar. 15, 1960. 33p. OTS.

The fuel surface temperatures and flow rate effects which might be produced by plugs in SRE fuel channels were investigated. It was found that plugs which locally insulate more than 20 to 30% of the surface of a fuel rod are dangerous. Heat transfer through the moderator would not significantly affect the sensitivity of the outlet thermocouple to change in mass flow through a fuel channel, provided the reactor power is above 2 Mw and the channel is not completely plugged. If a 5% or greater increase in a fuel channel Δt is taken to indicate that a plug exists in the channel, about 80% of all possible plugs will be detected and roughly 95% of all dangerous plugs will be detected by this criterion. (C.J.G.)

18637 NAA-SR-Memo-5011
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
A PRELIMINARY NUCLEAR ANALYSIS OF A SODIUM COOLED FAST REACTOR (SCFR) WITH UC FUEL ELEMENTS IN A SKEWED HEXAGONAL ARRAY. H. Jackel. Feb. 24, 1960. 18p. OTS.

Core dimensions and nuclear parameters were calculated for a sodium-cooled fast reactor containing UC fuel elements in a skewed hexagonal array. (C.J.G.)

18638 NAA-SR-Memo-5114
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
THE SODIUM GRAPHITE REACTOR: TOMMORROW'S POWER PLANT. R. J. Beeley, E. G. Lowell, H. Polak, and J. Renard. Apr. 25, 1960. 39p. Contract AT-11-1-GEN-8. OTS.

A description is given of the Advanced Sodium Graphite Reactor Power Plant, including the reactor, heat transfer systems, generating plant, control systems, and the economics of producing 256 Mw(e). The safety of this design is due to its unusually low operating pressure, absence of chemically incompatible materials in the core, and excellent stability under static and dynamic conditions. The reactor is being constructed at Hallam, Nebraska, at a probable cost of $160 to $190/kw, exclusive of the first core costs. The 151 fuel elements of uranium carbide are enriched to 2.75 at.% U^{235} and clad in stainless steel. The average thermal neutron flux in the fuel is 8×10^{13} n/cm^2-sec. (B.O.G.)

18639 NARF-60-16-T
Convair, Fort Worth, Tex.
ARGON ACTIVATION EXPERIMENT. D. G. Anderson. May 27, 1960. 32p. Contract AF33(600)-38946. (MR-N-260).

Spectral information was accumulated from the air surrounding the Aircraft Shield Test Reactor (ASTR) in experiments designed to yield qualitative and quantitative information on the activities produced while operating at high power levels. These investigations were necessary because of the proposed operations of the ASTR in the enclosed, dry-tank environment of the Expedient-Shield Experiment (Configuration I) and the 2-π geometry of the Shield-Shaping Experiment (Configuration II). An argon activity of about 2×10^{-10} μc/cc-watt was obtained with the reactor in Configuration I. No other significant activity was found. With the reactor in Configuration II at 3 Mw, the argon activity will not exceed the AEC maximum permissible level of 1.6×10^{-6} μc/cc. (auth)

18640 NDA-64-103
Nuclear Development Corp. of America, White Plains, N. Y.
SUMMARY OF DATA ON HIGH TEMPERATURE REACTOR FUEL ELEMENT MATERIALS. A. Strasser. Sept. 28, 1956. Decl. Mar. 25, 1960. 179p. Contract AT(30-1)-862. OTS.

Data on high-temperature reactor fuel element materials suitable for the High Operating Temperature Reactor are presented. Fuel recommendations are made for a gas-cooled reactor with a coolant exit temperature of 2500°F. (auth)

18641 NP-8778
Marquardt Corp. Nuclear Systems Div., Van Nuys, Calif.
TESTS OF THE MARQUARDT SERIAL 50B1 (TORY II-A) HEAVY-DUTY ENGINE. C. D. Hartman. Mar. 22, 1960. 49p. Contract AF33(616)-6214. (MR-60-109).

The Marquardt Serial 50B1 heavy-duty engine was tested in AF-MJL Cell 8 during January 1960 in conjunction with components of the Serial 24B3 hydrocarbon-fueled engine to evaluate its characteristics. A series of twelve runs was made, consisting of twenty-one minutes of air time at air-flows up to 520 pounds per second and nine minutes of burning time at exit temperatures exceeding 3500°F, during which the structural, aerodynamic, and heat transfer performance of the engine was demonstrated. (auth)

18642 NYO-2707
Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences.
FEASIBILITY STUDY ON CENTRIFUGE ENRICHMENT OF THE BY-PASS STREAM OF THE PEBBLE BED REACTOR. Final Report. H. M. Parker and John Mowat. Nov. 1959. 31p. For Sanderson and Porter. Contract AT(30-1)-2207, Sub[contract] S & P 1965-3. OTS.

Originally issued as Report No. EP-59-SAN-TR-1.

A feasibility study was made of centrifugation as a method of concentrating the contaminants of the Pebble-Bed Reactor gas stream. Application was made of the isotope separation theory to derive formulas for the total length of centrifuge needed to attain a given enrichment of a given by-pass flow. Formulas for equilibrium activity were written in terms of the separation theory parameters. Using both sets of formulas, the length of centrifuge vs. the activity reduction for different reactors and by-pass flows could be found. Results were calculated for the 125-Mw(e) Pebble-Bed Reactor. (M.C.G.)

18643 ORNL-858(Del.)
Oak Ridge National Lab., Tenn.
THE AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING AUGUST 31, 1950. C. B. Ellis and W. E. Thompson, eds. Dec. 4, 1950. Decl. with deletions Oct. 1959. 64p. Contract W-7405-eng-26. OTS.

Stainless steel harps were operated both under thermal connection and with an electromagnetic pump using Na and NaK. Experimental equipment for measuring molten metal heat transfer coefficients was essentially completed. Equipment for measuring the heat transfer to boiling liquids is being designed. Plans were made to irradiate Cu and 316 stainless steel in the 20 Mev proton beam of

the Y-12 cyclotron. The possibility of extending earlier thermal xenon cross sections vs. energy measurements to higher neutron energies is being considered. (W.L.H.)

18644 ORNL-919(Del.)
Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 10, 1950. C. B. Ellis and W. B. Cottrell. Feb. 27, 1951. Decl. with deletions Nov. 10, 1959. 160p. Contract W-7405-eng-26. OTS.

Design of the Aircraft Reactor Experiment (ARE) is continuing, with particular emphasis on shielding, control, and fuel material. The most promising fuel mixture for the ARE is a solution of UF_4 in NaF, with possible admixtures of other fluorides to lower the melting point to a convenient range. Extensive computations of criticality and thermal xenon coefficients were made for both bare reactors and reflected reactors. Graphs of the spectra of several solid-fuel reactors are included. A preliminary analysis of the fuel kinetics of the $NaF-UF_4$ reactor shows the existence of oscillation in the reactor power following a change in reactivity, which arises from the coupling between fuel displacement and neutron flux. A resonance at ~49 ev was found from the preliminary neutron cross-section measurements on Mo. Theoretical analyses of heat transfer were completed on three situations which approximate the entrance conditions involved in current ARE core designs. Equipment was designed for the measurement of thermal conductivity, specific heat, and other high-temperature properties of various liquid metals and molten salts. The specific heat of Li between 550 and 900°C was measured as 1.0 ± 10%. Both 316 and 347 stainless steel convection harps containing liquid Na have operated almost 800 hr at 1500°F without failure. Substances so far found to have good resistance to Na at 1800°F include types 316 and 347 stainless steel and Ni. Fair resistance under these conditions is shown by Mo, Ta, alloy N-155, Inconel, and Inconel X. The equilibrium diagram of the molten salt system $LiF-UF_4$ has been established, and study of such systems as $NaF-UF_4$ is underway. Preliminary corrosion studies of numerous metals in $NaF-UF_4$ at 1300°F for 160 hr show Hastelloy C, Inconel, and Mo to be the least attacked. (W.L.H.)

18645 ORNL-1439(Del.)
Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 10, 1952. W. B. Cottrell, ed. Decl. with deletions Nov. 16, 1959. 156p. Contract W-7405-eng-26. OTS.

The most significant ARE modification was the completion of the off-gas system design. Progress is reported on valves, pumps, instrumentation, and other components of the fluoride-fuel and reflector-coolant circuits. A rotameter-type flowmeter and the modified Moore Nullmatic pressure transmitter were tested. The heat-transfer coefficient of a sodium-to-air radiator was increased by 20%. General design studies include a performance study on a Sapphire turbojet engine. Reactor physics studies include those of oscillations in a circulating fuel reactor, a technique for reactor calculations, and the temperature-dependence of a cross section exhibiting a resonance. Measurements in several criticality tests are reported. The research on fused-fluoride systems led to selection of the fuel and charging technique for ARE. Continued study of the corrosion characteristics of ZrF_4 bearing mixtures, hydroxides, and liquid metals is reported. Metallurgy and ceramics research includes work on development of spherical solid fuel elements; creep rupture tests of structural metal; welding and brazing techniques; and cermets and ceramic coatings. Heat transfer and physical properties of several fluoride mixtures were studied. Radiation damage studies include irradiation of fluoride fuel samples, in-pile sodium-loop measurements, and in-pile creep measurements. Chemical, spectrographic, and petrographic identification of various impurities, corrosion products, and reduction products are reported. (For preceding period see ORNL-1375.) (J.R.D.)

18646 ORNL-1609(Del.)
Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 10, 1953. W. B. Cottrell, ed. Nov. 3, 1953. Decl. with deletions Nov. 12, 1959. 124p. Contract W-7405-eng-26. OTS.

A higher value was obtained for the critical mass for the Aircraft Reactor Experiment. The exact value of the critical mass was not determined, but it is expected that the reactor will be able to "go critical." Structural poisons were removed from the core. The increase in the critical mass reduced the heat removal capacity by one-half. Coincident with these changes, both the fuel and sodium systems were revised to operate with only one pump. Vertical-shaft, sump-type, gas-sealed centrifugal pumps are to be employed in both systems. Pump seals with packings of graphite, graphite and metal wood, and beryllium fluoride and various vitreous and frozen seals were tested for use in continuous remote operation. No seals for such an operation were found suitable; however, several seals operated in excess of 1000 hr with leakage rates of less than 10 cm^3 per day. Suitable instrumentation to indicate leaks in the sodium and the fluoride systems was developed. Reliable fluid-flow measurements were made by using two Moore pressure transmitters across a venturi. Several series of reactor and shield designs were made to determine the effects of reactor power, reactor core diameter, and division of the shield on aircraft performance. The activation of various secondary coolants, including Na and K, was measured. Sodium was found superior to K on the basis of total weight of the system, although the activity of the K was about 2 to 5% that of the Na. An analysis of a power plant system external to a reactor was made for a 200,000-lb aircraft with a 100- or a 200-Mw reflector-moderated reactor and two or four Wright turbo-jet engines. The analysis revealed that the off-design, as well as the normal performance and control of these subsonic planes, is satisfactory when four engines are employed with chemical augmentation. The critical experiment facility was used to determine the relation between minimum critical mass and uniform thermal-neutron flux. The assembly investigated consisted of concentric cylindrical aluminum shells filled with varying concentrations of aqueous uranyl fluoride solution. Critical height and mass were measured, based on theoretically determined fuel loadings, and found to be within 2.5% of the corresponding calculated parameters. Phase equilibria studies of UF_4, UF_3, ThF_4, and UCl_4 compounds were conducted. Problems in the preparation and purification of fluoride mixtures were investigated. The corrosion of Inconel by $NaF-ZrF_4-UF_4$ (50–46–4 mole %) was studied as a function of time and temperature. The initial corrosion rate (~ 1 mil/day) was higher at higher temperatures but decreased after several days by a factor of 10. Creep-rupture data were obtained for both coarse- and

fine-grained Inconel in fluorides at 815°C over the stress range 2500 to 7500 psi. The beneficial effect of adding ZrH_2 was demonstrated in additions as small as 0.1 wt. %. The corrosion of Inconel by fluorides at high fluid velocities was no greater than in static tests. Of several stainless steel convection loops tested with circulating lead, only the loop constructed of type 410 stainless steel did not plug. High-conductivity radiator fins were fabricated (copper clad type 310 or 346 stainless steel) and assembled into high-temperature high-performance radiator segments. The high-temperature physical properties of several molten fluorides, chlorides, and hydroxides were measured. The viscosity and density of the system $NaF-ZrF_4-UF_4$ (53.5–40–6.5 mole %) were measured. The corrosion of BeO by Na both under the influence of radiation and without radiation was studied. Spectrometric analysis revealed no gross segregation of the U in irradiated fluoride fuels. The determination of Zr in fluorides by a spectrophotometric technique utilizing the zirconium–alizarin red-S complex is described. (For preceding period see ORNL-1556.) (C.J.G.)

18647 ORNL-2920

Oak Ridge National Lab., Tenn.

HOMOGENEOUS REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1960. Apr. 29, 1960. 137p. Contract W-7405-eng-26. OTS.

Homogeneous Reactor Test. During run 21 the reactor operated continuously for 105 days and generated ~5600 Mwh(th). The major objective of the run was the investigation of fuel stability. The multiclone-hydroclone solids separation system was operated in two periods for a total of 410 hr in run 21. Solids removal rates were a factor of 3 to 5 lower than in comparable periods in run 20, substantiating earlier evidence that the malfunction which was indicated later in run 20 was not corrected by replacement of the hydroclone with a spare prior to run 21. The xenon poisoning at 5 Mw was 0.95%. The Zircaloy wear rings of a test pump ignited while the pump was being operated as a steam-oxygen blower with rubbing contact of the wear rings. A universal periscope manipulator which provides for gear-driven movements and smooth rotation of various optical core-inspection devices was designed, constructed, and tested. Tests of a Laud Electrocaloric flowmeter revealed that the fluctuations in indicated flow rates observed were due to oscillations produced by a large distance-velocity lag which is present at low flow rates. Radiation tests of a miniature television camera were reported by using nonbrowning lens; 9.6×10^7 r of gamma radiation was accumulated over a period of 248.5 hr. Reactor Analysis and Engineering Development. A two-group, two-dimensional criticality calculation for cylindrical geometry was programmed for the IBM-704. The stator of the 20-cfm blower was examined and was found to have failed by the short to ground of a stator slot. Failures of the third-stage diaphragm of the oxygen compressor, for recycling contaminated gas, are reported. Calculations were made of the temperature distribution in a 4-by-12-ft cylindrical core with straight-through flow. The preliminary mechanical design of a 380 Mw (thermal) two-region breeder reactor having a slurry blanket and solution core was completed. Effects of ThO_2 concentration, temperature, and flow rate on the homogeneity of slurry flowing in a horizontal $3\frac{1}{2}$-in. pipe are being studied. In order to investigate the caking and plugging observed with mixed U–Th oxide in run 3B, run 4B was initiated with a pure 1600°C-fired ThO_2 believed immune to caking and plugging. As part of a program to test and evaluate electronic instrumentation systems for possible use in future reactor systems, a Foxboro model M/62 universal controller was tested. Sample coupons of Coors Porcelain Company Al_2O_3 were tested in high-temperature oxygenated water to determine the suitability of Al_2O_3 for use as a liner material for magnetic flowmeters. A prototype flush-diaphragm differential-pressure transmitter was tested. Solution Fuels. The response of typical reactor fuel solutions to the sudden addition of H_2O_2 or solid uranium peroxide was investigated. The maximum permissible power density for a homogeneous reactor solution was related to the uranyl ion concentration, the acidity the UO_4 solubility, and the equilibrium constant. Laboratory experiments to determine temperatures of immiscibility for synthetic HRT fuels and their concentrates were continued. Over-all solubility data are presented for the system $UO_3-CuO-NiO-SO_3-H_2O$, its D_2O analog, and its included four- and three-component systems. The effect of the mole ratio, UO_3/SO_3, on immiscibility temperatures of 0.02, 0.05, and 0.20 m SO_3 solutions was determined. The critical velocity for cast type CD4MCU stainless steel was shown to be about the same as that for cast type 347 stainless steel in 0.04 m UO_2SO_4, 0.025 m D_2SO_4, 0.002 m $CuSO_4$ at 250°C. Batch-type experiments were performed to study the sorption of U on hydrous zirconium oxide from UO_2SO_4 solutions at 250°C. Slurry Fuels. The rheological characteristics of two suspensions of spherical ThO_2 particles were determined for comparison with earlier results on irregularly crystalline ThO_2. The effects of slurry velocity and confining-metal surface on cake formation were investigated with slurries composed of particles more resistant to degradation than the 800°C-calcined ThO_2 of earlier studies. A long-term irradiation test of 25-μ Houdry ThO_2 spheres containing 0.5% U was begun. Gas-recombination rates sufficient to maintain 0.4 and 1.2 w/ml at 280°C and 100 psi H_2 were obtained with Pd concentrations of 60 and 120 ppm, based on ThO_2, respectively. Corrosion-erosion by D_2O slurries of experimental flame-calcined ThO_2, Th–U oxides, and Th–U–Al oxides, as indicated by attack rates of type 347 stainless steel, titanium, Inconel, and Zircaloy-2, was found in toroid screening tests to be about the same as that normally shown by slurries of ThO_2 prepared by regular-production methods. Studies of the kinetics of recombination of D_2 and O_2 at 280°C were made in the loop while circulating slurry containing a Pd catalyst. Fuel Manufacture and Processing. Mixed oxides containing 3 at. % U prepared by an adsorption method can be fired to 1200°C without significant increase in clinker formation if held at 1000°C for 4 hr before increasing to 1200°C. Coprecipitation of Al with thorium oxalate by the usual oxalate precipitation technique was unsuccessful. Metallurgy. The collection of data from the study of the effects of fabrication variables on the anisotropy of mechanical properties and strain in Zircaloy-2 was completed. Quenching temperature and quenching-rate studies are reported for Zr–15% Nb alloys. (For preceding period see ORNL-2839.) (W.L.H.)

18648 TID-5944

Duquesne Light Co., Shippingport, Penna.

MONTHLY OPERATING REPORT, MARCH 1960. 30p. Contract AT(11-1)-292. OTS.

The station was shutdown for refueling. The 1A, 1B, and 1C reactor coolant pumps were rotated and the 1D pump was installed. Routine sampling was carried out on the cooling water system, the primary water storage tank, and the canal water system. Two chemical waste tanks and three surge tanks were filled, tested, and processed during

March. Radiation intensities around the canal water demineralizers were decreased following replacement of the resin. In the refueling program, all seal welds were completed, the reactor vessel was vented, and a successful hydrostatic test was performed. General maintenance and testing are summarized. The type and extent of training during the month are discussed. (See also TID-5714.) (W.D.M.)

18649 TID-6033

Atomic Power Development Associates, Inc., Detroit.
DETAILED CONCEPTUAL DESIGN OF THE GRAPHITE PRIMARY SHIELD FOR THE ENRICO FERMI FAST BREEDER REACTOR. Technical Memorandum No. 23. R. J. Beaudry, W. F. Chaltron, and H. E. Hungerford. Dec. 15, 1959. 98p. Contract AT(11-1)-476. OTS.

The detailed final conceptual design is presented for the graphite portion of the primary shield which surrounds the reactor vessel of the Enrico Fermi Atomic Power Plant. This shield will consist of blocks of plain and borated graphite or semi-graphite material arranged in layers within the primary shield tanks in specified patterns at each elevation. Each configuration was accurately determined by calculation. All objects in the shield area, such as pipes and pipe hangers, wiring, junction boxes, and other obstructions, were taken into consideration in the design. The boron concentration for the borated material is either 5 or 7 wt.% boron. In some areas in the thicker portions of the shield, brick filler blocks were specified. Steel gamma shielding was included in the upper regions of the shield. (auth)

18650 TID-8503(Pt. 3)

Sargent and Lundy, Chicago and Nuclear Development Corp. of America, White Plains, N. Y.
HEAVY WATER MODERATED POWER REACTOR PLANTS—DESIGN STUDY. June 1959. 415p. Contract AT(38-1)-193, Mod. 1. OTS.

Previously available as SL-1653, Part 3.

Studies of basic design parameters for heavy water moderated reactor plants and systems of prototype plants and further development program requirements are examined. The general objective was to assure maximum utilization of currently available information in the design of the components and systems of the plants. While each part of the study was evaluated in terms of its effect on the plant design, as well as other factors related to performance characteristics, construction, operating costs, and the construction schedule; it is a general conclusion that no major changes are required in the design of either the prototype plant or the full-scale plant on the basis of the parameters studied. To this extent, the studies provided confirmation of the major decisions affecting plant designs which were made during Parts 1 and 2 of the study. (auth)

18651 TID-8524

Puerto Rico Water Resources Authority, [San Juan] and General Nuclear Engineering Corp., [Dunedin, Fla.].
BOILING NUCLEAR SUPERHEATER (BONUS) POWER STATION PRELIMINARY DESIGN STUDY AND HAZARDS SUMMARY REPORT. VOLUME 1. REFERENCE DESIGN. VOLUME 2. TECHNICAL AND ECONOMIC EVALUATION OF REFERENCE DESIGN. VOLUME 3. ALTERNATE DESIGN STUDIES. VOLUME 4. PRELIMINARY HAZARDS SUMMARY REPORT. June 1960. 940p. OTS.

Volumes 1 through 3 may be further identified as PRWRA-GNEC-3 and Volume 4, as PRWRA-GNEC-2.

Studies of the feasibility, safety, and economy of small integral boiling-superheating reactors resulted in the preliminary design of a 17.3-Mw(e) boiling nuclear superheater power station (BONUS). Slightly enriched UO_2 was selected as the fuel material for both the boiler and superheater regions of the reactor. Zircaloy-2 cladding is used on fuel elements in the boiler region of the core, and rod-type fuel elements, clad in AISI Type-316 stainless steel, are used in the superheater fuel assemblies. The reactor is designed to produce 50 Mw(t). It is controlled by 17 boron–stainless steel rods. Each of the two sections of a boiling water fuel assembly and each superheater fuel assembly consist of 32 fuel rods. Shielding dimensions, coolant flow rates, and steam parameters are discussed. Instrumentation and control facilities, electrical systems, and safety facilities are described. A hazards evaluation of the reactor is presented. Alternates to the reference design are contained. (C.J.G.)

18652

BURN-UP IN A URANIUM REACTOR. Addendum to ASEA Research No. 2, 123-35(1959). Ragnar Liljeblad and Ingvar Oljelund (ASEA, Västerås, Sweden). ASEA Research, No. 3, 45-6(1959). (In English)

A means is reported for determining the critical plutonium content with time and the corresponding burn-up during the operation of a reactor using enriched fuels. Two cases are illustrated for Pu^{239} enrichment; they are: $N_{039} = 0.56N_0$ and $0.58N_0$. A very slight decreasing value of Pu^{239} is obtained for the former, while for the latter a practically constant concentration is obtained. The burn-up rates are 4,100 and 2,600 kwd/kg, respectively. (B.O.G.)

18653

THE APPLICATION OF HEAT STORAGE IN NUCLEAR AND CONVENTIONAL POWER STATIONS. Fritz Marguerre (Grosskraftwerk Mannheim A. G., Baden-Baden Ger.) and Ferdinand Marguerre (Grosskraftwerk Mannheim A. G., Heidelberg, Ger.). Brennstoff-Wärme-Kraft 12, 290-3(1960) June. (In German)

Economics of the cooperation of nuclear power stations with power stations of the common kind was investigated. Thermal storage (especially as a combination of feed-water and pressure-reduction storage in a single accumulator vessel with one turbine) represents an ideal method of adapting both types of power plants to the demands of the transmission network and makes possible a considerable reduction of generating costs. Even greater economies resulted from additional steam superheating with fossile fuels. The effects of these measures on the operating cost of the nuclear plant and of orthodox thermal power stations was demonstrated through examples. (auth)

18654

ANALOGUE SIMULATION FOR THE SPEED CONTROLLER OF THE LATINA POWER STATION CO_2 BLOWERS. E. Torielli, M. De Bacci, V. Gervasio, and C. Zaffiro (AGIP Nucleare, Milan). Energia nucleare (Milan) 7, 333-41(1960) May. (In English)

The CO_2 circulation plant of the nuclear reactor at Latina is considered to study its transient behavior. A mathematical model of the system supplies a set of dynamic equations which were solved by means of an analog computor; an opening characteristic for the turbine steam inlet valve was suggested so that the transient response to a step input of the system does not depend on the blower speed. In these conditions the parameters which affect the control loop stability may be adjusted. (auth)

18655

A MONTECARLO CALCULATION OF THE N^{16} PRODUCTION IN A LATINA TYPE REACTOR. E. Diana, A. Kind, and V. Pierpaoli (AGIP Nucleare, Milan). Energia nucleare (Milan) 7, 342-9(1960) May. (In English)

The Monte Carlo method is applied to the calculation of the radioactive N^{16} production taking place in the cooling channels of a heterogeneous natural uranium graphite reactor because of the fast neutron radiation on CO_2. The rate of N^{16} production is given as a function of reactor power. (auth)

18656

INFORMATION ON THE LATINA NUCLEAR POWER STATION. G. Calabria (AGIP Nucleare, Milan). Energia nucleare (Milan) 7, 385-96(1960) June. (In Italian)

Information on the present work conditions, particular design, and constructional problems connected with the Latina nuclear power station are given. This plant is the most advanced construction in Italy in the field of electric power produced by nuclear fission and consists of a natural uranium, graphite moderated gas cooled reactor which supplies 3 turbogenerators with a net output of 200 Mw. The station is expected to be operating in the first half of 1962. (auth)

18657

AN ANALOG STUDY OF THE BOILER DYNAMICS IN A NUCLEAR POWER PLANT. F. Faldini, V. Gervasio, and C. Zaffiro (AGIP Nucleare, Milan). Energia nucleare (Milan) 7, 426-34(1960) June. (In English)

A mathematical model of the transient behavior of a steam generator connected with a nuclear power plant of the Calder Hall type (Latina) is presented. Steam pressure response following CO_2 mass flow and load changes was investigated with an analogue computer. Experimental data obtained on an operating boiler and theoretical results are compared and a good accordance is found. (auth)

18658

THE NUCLEAR PASSENGER-CARGO SHIP "SAVANNAH." Jacqueline Juillard. Inds. atomiques 4, No. 3-4, 105-9 (1960). (In French)

The nuclear design and characteristics of the "Savannah" are described with a discussion of the reactor, reactor enclosure, and the outfitting of the ship. (J.S.R.)

18659

A TYPE OF ATOMIC POWER STATION TURBOGENERATOR. M. M. Kogan. Kernenergie 1, 176-80(1958) Mar. (In German)

The thermal power station must be taken as the basis for development of atomic power stations. Atomic power stations permit not only fuel economics in producing electricity but also heat for heating and for hot water. This is especially important for areas which have no fuel of their own. The conventional turbogenerator with controllable steam demand and condensation, as used for power stations with a remote heating installation, does not offer a constant load for the reactor, so it cannot be used for atomic power stations. Thus, in connection with this problem, a new type of turbogenerator is suggested which allows a constant steam demand at the high-pressure stage, while the quantity of steam generated at the low-pressure stage changes as a function of the quantity of steam required for other purposes. In the case where no heat is needed for other purposes, equal quantities of steam flow through both stages. The proposed turbogenerator can be operated with varying loads which can increase, by shutting off the intermediate steam demand, to 38 to 69% of the performance of common generators (depending on the live steam parameter chosen). Such a turbogenerator provides a constant reactor load. (tr-auth)

18660

ATOMIC LOCOMOTIVE. Kernenergie 1, 226-9(1958) Mar. (In German)

The design requirements for an atomic-powered locomotive are set out, and work done on the project is reviewed. The Borst concept which involves a 30-Mw homogeneous reactor and steam turbine is described. The Gunnel-type using an 11-Mw heterogeneous reactor and gas turbine is also discussed, along with another type which uses UF_6 fuel. (T.R.H.)

18661

DRAGON: GENERAL DESCRIPTION. Nuclear Eng. 5, 302-5(1960) July.

A description is given for the Dragon 20-Mwh helium-cooled reactor, now in the final design stage and about to be constructed. Since it operates at high temperatures, gaseous products are not contained but are removed by the coolant. The following topics are covered: core, control, reactor vessel, coolant, charge machine, fission product removal, shielding and containment, ventilation, auxiliary buildings, and supplies. A review of construction progress is also given; it is expected to achieve criticality in 1963. The general arrangement of the reactor is shown in a fold-out drawing. (D.L.C.)

18662

DRAGON: CONTROL SYSTEM. J. R. Dean (OEEC High Temperature Reactor Project, AEE, Winfrith Eng.). Nuclear Eng. 5, 306-9(1960) July.

The control system for the Dragon 20-Mwh helium-cooled reactor is outlined in some detail. Twenty-four absorber rods containing boron carbide are to be lowered into holes in the reflector near the core edge. Their drive mechanisms and the motor are described at length; the motor is a stepping motor developed for operation in any direction and at any speed, and it serves as a means of control since it is sensitive to overload or obstruction. The gearbox scheme is also given together with maintenance and lubrication problems which may arise. In reactor operation, the motor will lower only one rod at a time; one rod will be used for automatic regulation of gas outlet temperature and 3 or 4 rods will be safety rods, while the remaining rods will be under manual control. All rods can be released by an emergency button. (D.L.C.)

18663

DRAGON: FUEL ELEMENTS. Eric Smith (OEEC High Temperature Reactor Project, AEE, Winfrith, Eng.). Nuclear Eng. 5, 310-13(1960) July.

The core zone of the Dragon 20-Mwh helium-cooled reactor consists of 37 elements with 7 fuel rods in each, totaling 259 fuel rods. A fuel rod is thorium-uranium fuel surrounded by a graphite box; the assembly is restrained radially by the pressure drop in the coolant channels. For the purpose of keeping activity at low limits, the graphite box is impregnated sufficiently so that diffusion of gaseous fission products is delayed for at least 1 hour, and a gap is introduced between the fuel and the box for a small coolant purge. Details of fuel rod construction are given together with heat transfer and thermal stress equations and characteristics. (D.L.C.)

18664

DRAGON: GRAPHITE. R. A. U. Huddle, P. A. P. Arragon, and M. S. T. Price (OEEC High Temperature Reactor Project, AEE, Winfrith, Eng.). Nuclear Eng. 5, 314-15(1960) July.

Nearly the entire core and reflectors of the Dragon 20-Mwh helium-cooled reactor are to be constructed from graphite, which means that several different types of new graphites are needed. The requirements for

these graphites are given: (1) high densities on the order of 2.0 g/cm^3, (2) low permeabilities on the order of 10^{-6} cm^2/sec, and (3) satisfactory performance at high temperatures up to 1700°C. (1) is necessary for reactor economy, and the reason for (2) is the need to delay fission product diffusion through the fuel box for at least 1 hour. Graphite, a notorious absorber of water vapor, must be completely degassed. The graphite requirements are also discussed on the basis of three separate groups, the outer reflector, the inner removable reflector, and the fuel elements. A graphite has been manufactured for fuel rod cans, based on Morgan Crucible's EY9 and impregnated with furfuryl alcohol; its designation is CY119. (D.L.C.)

18665

CONTROL OF POWER REACTORS. [PART] I. R. H. Campbell (United Kingdom Atomic Energy Authority, Risley, Eng.). Nuclear Power 5, No. 51, 68-72(1960) July.

In power reactors, control over positive temperature coefficients of reactivity is provided by the U^{238} component of the fuel and the large thermal inertia of the moderator. However, if the moderator is in close association with the fuel, as in recent reactor designs, the response is much more rapid, which may affect manual handling of the reactor. While manual control is still possible in a reactor with positive temperature coefficients, automatic control is preferred because of the high cost of spurious trips in a reactor feeding power to a grid. Types of instability possible in civil magnox reactors are outlined; they can be controlled by splitting the reactor into zones and automatically controlling the power level in each loop independently. Normal phase techniques for loop stability are derived for low frequencies using a linear approach in order to give a clear view of the effects of the various terms. The necessary techniques are given for finding the transfer function of the controller. The advantages of the analog computer for control system stability studies are pointed out together with its disadvantage of noise. (D.L.C.)

18666

NUCLEAR POWER COSTS REASSESSED. Nuclear Power 5, No. 51, 73-5(1960) July.

Economic studies on nuclear power vs. coal power in Great Britain are reviewed; the year in which nuclear power is expected to become competitive with coal power has been moved back into the future from 1965 to 1967 on a 75% load basis. The reason for this postponement is an overestimate of coal power costs, which are now expected to decrease up to 1965. Magnox and advanced gas-cooled reactors are discussed together with arguments by C. Hinton, H. G. Nelson, C. R. King, and R. D. Vaughan. Direct generation of electricity and other future possibilities are discussed. It is agreed that demand for electricity in the future will increase and force nuclear power to be used for that purpose; about its role today, however, there is some disagreement. Some believe that reactor research must wait for the future and be limited to one or two power stations per year, while others, particularly those in industry, believe that this progress rate is too slow. (D.L.C.)

18667

THE ECONOMIC USE OF CONVENTIONAL AND NUCLEAR FUEL. F. A. P. M. Theunissen (Shell Internationale Research Maatschappij N. V., Hague). Nuclear Power 5, No. 51, 76-9(1960) July.

Hybrid nuclear power stations are shown to be the most economic answer for nations having large national grids and seeking experience in nuclear power generation. At relatively high conventional fuel costs, the optimum hybrid capacity seems to be between 40 and 50% of the total system capacity; the remainder will have to be supplied by conventional stations. (D.L.C.)

18668

BUILDING THE AGR. David Iggulden. Nuclear Power 5, No. 51, 84-7(1960) July.

The Advanced Gas-cooled Reactor (AGR) project, composed of the AGR and Hero reactors, is expected to be finished and in operation sometime in 1961. The AGR reactor is described: containment building, refueling machine, control rod and auto control rod mechanisms, and pressure vessel. A table of characteristics is given for the AGR. (D.L.C.)

18669

BOUNDEDNESS AND STABILITY IN NONLINEAR REACTOR DYNAMICS. Elias P. Gyftopoulos and Jacques Devooght (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng. 7, 533-40(1960) June.

A formulation of the problem of boundedness and stability of the power level of a nuclear reactor describable by a nonlinear model is presented. A sufficient criterion for boundedness and stability is derived and proved to be equivalent to the criterion suggested by Welton. The criterion is illustrated by means of two examples. (auth)

18670

THE POSSIBLE INSTABILITY OF THE POWER DENSITY AND XENON CONCENTRATION IN A LARGE THERMAL POWER REACTOR. H. Märkl (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik 2, 90-100(1960) May. (In German)

The oscillations of the neutron flux and the xenon concentration possibly occurring in a thermal power reactor as a result of the feedback between fluctuations of the power density and the xenon production in spite of total power being kept constant were investigated. By application of the Laplace transformation and use of matrix methods the problem can be formulated and solved after suitable linearization of the corresponding equation system. Fluctuation of the total power can be eliminated with suitable expressions. The stability behavior as a function of reactor dimensions and flux height was investigated by means of an example. (tr-auth)

Production Reactors

18671 ANL-6122

Argonne National Lab., Ill.

PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959. G. Fischer, C. Kelber, D. Meneghetti, P. Persiani, D. Shaftman, and A. B. Smith, eds. 399p. OTS.

Abstracts were prepared on 26 of 28 papers presented at the Conference on the Physics of Breeding held at Argonne National Laboratory on October 19 to 21, 1959. (C.J.G.)

18672 ANL-6122(p.23-32)

Argonne National Lab., Ill.

ON THE DEFINITION OF BREEDING. Bernard I. Spinrad. p.23-32 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Various definitions of breeding are presented and discussed. Steady-state conditions, partial breeding, and fuel production rates are considered. (C.J.G.)

18673 ANL-6122(p.77-92)

Los Alamos Scientific Lab., N. Mex.

A COMPUTATIONAL SURVEY OF IDEALIZED FAST BREEDER REACTORS. William H. Roach. p.77-92 of

PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Multigroup calculations of nuclear parameters of idealized fast breeder reactors are presented. The systems U^{235}–depleted uranium, Pu^{239}–depleted uranium, and U^{233}–thorium were set up as critical radii problems and solved using the S_4 approximation in the SNG code. Critical mass, conversion ratio, and breeding ratio were computed for each system. (C.J.G.)

18674 ANL-6122(p.93-100)
Argonne National Lab., Lemont, Ill.
THE SENSITIVITY OF BREEDING RATIO IN FAST REACTORS TO UNCERTAINTIES IN CROSS SECTIONS. David Okrent. p.93-100 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The sensitivity of the breeding ratio in fast reactors to uncertainties in cross sections was investigated. The uncertainties investigated include the effects of various types of structural materials, the effects of fission products, and the effects of different assumptions on inelastic scattering, alpha, and fission product capture properties. (C.J.G.)

18675 ANL-6122(p.101-15)
Los Alamos Scientific Lab., N. Mex.
BREEDING: INTERNAL OR EXTERNAL? Robert M. Kiehn. p.101-15 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Material composition, geometrical shapes, spectrum changes, lattice arrangements and their effects on new fuel production and heat transfer are examined for internal and external breeding systems. The effects of changes in the above parameters on internal breeding in a system consisting of a molten Pu–Co–Ce alloy contained in tantalum and cooled by sodium were studied. (C.J.G.)

18676 ANL-6122(p.116-33)
General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
PARAMETRIC ANALYSIS OF A PuO_2–UO_2 FUELED FAST REACTOR. Paul Greebler and Peter Aline. p.116-33 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The physics characteristics of a PuO_2–UO_2 fueled fast reactor were investigated over a range of design parameters. The physics properties investigated include the breeding ratios, doubling time, required plutonium fuel loading, sodium temperature coefficient of reactivity, and the excess operating reactivity which must be held down by control rods as a function of the refueling interval. (C.J.G.)

18677 ANL-6122(p.137-48)
Argonne National Lab., Ill.
BREEDING IN FAST PLUTONIUM METAL SYSTEMS WITH EBR-II-TYPE RECYCLE. Harry H. Hummel. p.137-48 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The effect of using a fuel processing system similar to that employed by the EBR-II reactor for an 800-liter core plutonium-fueled fast reactor is investigated. The effect of fission product poisoning on the breeding properties of such a reactor is discussed. (C.J.G.)

18678 ANL-6122(p.149-62)
Atomic Power Development Associates, Inc., Detroit.
Pu–U AND U^{233}–Th CERMET-TYPE FAST BREEDERS. John B. Nims. p.149-62 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The breeding characteristics of neutron adsorption and economy, critical mass, and breeding ratio were determined for the following cermet systems: PuC–U–Mo and U^{233}C–Th. (C.J.G.)

18679 ANL-6122(p.177-85)
Argonne National Lab., Ill.
BREEDING IN COUPLED FAST-THERMAL SYSTEMS. Robert Avery. p.177-85 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Neutron inventory and breeding ratio were calculated for two coupled fast-thermal systems. One system is cooled with sodium and consists basically of a thermal system surrounding the fast core. The other system is cooled with water and D_2O steam. (C.J.G.)

18680 ANL-6122(p.296-305)
Brookhaven National Lab., Upton, N. Y.
THE EFFECT OF HIGHER ISOTOPE PRODUCTION ON BREEDING. M. M. Levine. p.296-305 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The effects of equilibrium amounts of higher isotopes and fission products on breeding ratios for systems containing only U^{233} and moderator were investigated. (C.J.G.)

18681 ANL-6122(p.306-18)
Oak Ridge National Lab., Tenn.
BREEDING RATIOS, DOUBLING TIMES, AND FUEL COSTS IN AQUEOUS HOMOGENEOUS THORIUM BREEDER REACTORS. Paul R. Kasten. p.306-18 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The factors effecting breeding ratios, doubling times, and fuel costs in aqueous homogeneous thorium breeder reactors are analyzed. The effects of blanket thickness and Group-3 poisons on fuel costs were calculated. Breeding ratios were calculated for various reactor sizes and blanket fuel concentrations. A fuel-processing flowsheet for a two-region homogeneous thorium breeder reactor is contained. (C.J.G.)

18682 ANL-6122(p.319-34)
Babcock and Wilcox Co. [Atomic Energy Div.], Lynchburg, Va.
LIQUID METAL THORIUM BREEDER REACTORS. C. E. Thomas. p.319-34 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Design parameters of the Liquid Metal Thorium Breeder Reactor (LMTBR) are presented. The breeding ratio of the reactor is discussed relative to material cross sections, fission product poisons, effects of higher uranium isotopes, protactinium losses, and neutron leakage. Specific power and doubling time are calculated as a function of core diameter. The economics of the reactor are discussed relative to capital investment, bismuth and thorium inventories, and fuel inventory and production. (C.J.G.)

18683 ANL-6122(p.335-41)
Oak Ridge National Lab., Tenn.
OPTIMIZING THE MOLTEN-SALT REACTOR FOR MINIMUM DOUBLING TIME. H. G. MacPherson. p.335-41 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The breeding advantages of a heterogeneous, graphite-moderated, two-region, molten salt, thorium breeder and a fuel tube-type thorium breeder are discussed relative to optimization for minimum doubling time. It is shown how to adjust the values of core diameter, volume fraction of fuel in the core, and thorium concentration in the core to

design a molten salt breeder reactor with a minimum doubling time. (C.J.G.)

18684 ANL-6122(p.345-56)
Oak Ridge National Lab., Tenn.
GAS-COOLED BREEDER REACTORS. Alfred M. Perry. p.345-56 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

The performance and operation of a U^{233}-fueled graphite-moderated helium-cooled breeder reactor which employs a movable curtain of moderating material to divert neutrons from the fertile blanket to the core as fission poisons accumulate are discussed. Calculations of η, neutron adsorption losses, and power density were made. Similar calculations were made for BeO_2 plates cooled with CO_2. (C.J.G.)

18685 ANL-6122(p.370-83)
Nuclear Development Corp. of America, White Plains, N. Y.
A MIXED REACTOR FOR HIGH CONVERSION RATIO. R. C. Ross, K. Kniel, and P. Marnell. p.370-83 of PROCEEDINGS OF THE CONFERENCE ON THE PHYSICS OF BREEDING, OCTOBER 19-21, 1959.

Designs of a sodium-deuterium reactor configuration for use as a breeder reactor are given. Calculations were made of the conversion ratio, breeding ratio, and neutron balance, considering only Pu^{239} and U^{238} as fertile material. (C.J.G.)

18686 CF-60-4-110
Oak Ridge National Lab., Tenn.
GAMMA AND BETA HEAT GENERATION RATES IN THE HFIR CORE. Neil Hilvety. Apr. 29, 1960. 15p. OTS.

A calculation was made to determine the fuel plate heat fluxes resulting from after shutdown fission product heating. Fission product source strengths were obtained via the IBM Internuc code. Slab geometry was assumed. The results indicated that the maximum heat flux would occur slightly inboard of the center of the fuel annulus, with the heat flux at the inner annulus radius running about 8% below the maximum, and the outer radius heat flux 10% below the maximum. For decay times of 1.0, 10, 10^2, 10^3, 10^4, and 10^5 seconds the maximum calculated fuel plate heat fluxes were 42.0, 30.0, 18.0, 9.5, 4.0, and 1.3×10^3 Btu/hr-ft^2, respectively. The core coolant gamma heating rate during reactor operation was also calculated using the same techniques, but including the fission and capture gamma sources. Average coolant gamma heat generation rate was about 33 watts/cc at the start of the fuel cycle, and 57 watts/cc after the fission products built up. (auth)

18687
BREEDING RATIO IN U^{233} AND Pu^{239} FUELED REACTORS. Melvin M. Levine (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 7, 545-51(1960) June.

Breeding ratios for clean near-thermal systems containing only U^{233} and moderator were presented by Chernick and Moore. Pu^{239} systems were also investigated and the results in both systems extended to take account of the effects of the higher isotopes and fission products. The extra absorption by these higher isotopes tended to depress the breeding ratio, but fission in U^{235} or Pu^{241} compensated for this, and the net effect was an increase in breeding ratio for plutonium-fueled systems. (auth)

Research Reactors

18688 AECL-990(Paper 5)
Atomic Energy of Canada Ltd., Chalk River, Ont.
ORGANIZATION OF REACTOR OPERATION. J. H. Collins. Paper 5 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 11p.

After a reactor has been designed and constructed, it must then be operated safely and efficiently. The problems discussed are those of organization, training, the preparation of reliable manuals, and the establishment of satisfactory procedures. (W.D.M.)

18689 APEX-536
General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
SUMMARY HAZARDS EVALUATION OF THE SMR FACILITY. J. D. Simpson. Dec. 1959. 60p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

A description of the mechanical and electrical features of the SMR facility is given. A range of effects for various reactors utilizing this facility and undergoing the maximum credible accident are evaluated. The effects of an overloaded reactor are seen to be rather insensitive to the amount of overloading. The results of a maximum credible accident are that the test cell probably would not rupture and that people outside the plant environment would receive a noninjurious maximum calculated dose of only 3 rads. (auth)

18690 CF-60-5-19
Oak Ridge National Lab., Tenn.
ACTIVITY DUE TO N^{16} AND N^{17} IN THE HFIR PRIMARY COOLANT. H. A. McLain. May 25, 1960. 32p. Contract [W-7405-eng-26]. OTS.

The concentrations of and activities due to N^{16} and N^{17} in the HFIR primary coolant water were calculated. At the pressure vessel exit, the N^{16} activity is 3.9×10^6 dis/sec-ml and the N^{17} activity is 6.9×10^2 dis/sec-ml. Comparison of the N^{16} activity with the data obtained from the ORR water system indicates that the calculated results are slightly conservative. (auth)

18691 CF-60-6-52
Oak Ridge National Lab., Tenn.
ACTIVITY IN THE HFIR PRIMARY COOLANT SYSTEM AFTER A MELTDOWN OF THE FUEL IN REACTOR. H. A. McLain. June 10, 1960. 17p. Contract W-7405-eng-26. OTS.

An estimate was made of the fission product activity which would result in the HFIR primary coolant system following a meltdown of the fuel element within the reactor. The rare gases and the halogens appear to be the main contributors to the gamma activity in the coolant system immediately after the meltdown, and iodine appears to be the main contributor 24 hours after the meltdown. (auth)

18692 IDO-16563
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
ETR CYCLE 18 THERMAL AND FAST NEUTRON FLUX MEASUREMENTS. L. D. Weber and C. H. Hogg. June 20, 1960. 47p. Contract AT(10-1)-205. OTS.

The thermal and fast neutron fluxes in selected positions of the ETR were measured for Cycle 18. A flux map of the ETR tank and traverses for all positions monitored are contained. (auth)

18693
THE TURRET EXPERIMENT AT LOS ALAMOS SCIENTIFIC LABORATORY. John H. Russell (Los Alamos Scientific Lab., N. Mex.). J. Franklin Inst. Monograph Ser. No. 7, 127-32(1960) May.

The Turret experiment at Los Alamos is described.

This experiment was planned to determine the behavior of unclad, porous graphite fuel elements, impregnated with fully enriched uranium, in a 3Mw(th) reactor. The feasibility of producing helium at 2400°F for process heat use was to be demonstrated. (Studies of deposition and removal of volatile fission products were also planned. (M.C.G.)

18694

THE BLACK VOID REACTOR CONCEPT. C. O. Muehlhause (National Bureau of Standards, Washington, D. C.). Nuclear Sci. and Eng. 7, 505-7(1960) June.

The application of heavily loaded cylindrical fuel elements to two principal reactor configurations is considered. The objective of the work is the design of research reactors suitable for radiation effects studies. (auth)

18695

CRITICALITY STUDY ON TREAT REACTOR—CAUSE OF EXCESS BORON IMPURITY IN GRAPHITE. H. P. Iskenderian (Argonne National Lab., Ill.). Nuclear Sci. and Eng. 7, 554(1960) June.

Criticality calculations for the TREAT Reactor indicated a critical radius of 59 cm. However, TREAT became critical at a radius of 67.8 cm. The discrepancy was found to be due to boron impurity in the graphite in excess of 1.0 ppm allowed in the original specifications. Studies seemed to indicate that the excess boron was picked up when the fuel tubes were baked in borated stainless steel separators. (M.C.G.)

18696

THE RESEARCH REACTOR OF THE GERMAN DEMOCRATIC REPUBLIC AND ITS APPLICATION POSSIBILITIES. Heinz Barwich. p.7-24 of "Das Zentralinstitut für Kernphysik am Beginn Seiner Arbeit." Heinz Barwich, ed. Berlin, Akademie-Verlag, 1958. 59p. (In German)

The Research Reactor of the German Democratic Republic is a heterogeneous reactor using 10% enriched uranium as fuel. The fuel rods are clad with aluminum. Water is used as moderator, coolant, and reflector. The reactor shielding consists of water, cast iron, and concrete. The reactor has a maximum power of 2000 kw and a thermal neutron flux of 1×10^{13}. The reactor design and its control and safety systems are described. The proposed investigations to be made with the reactor are briefly reviewed. (J.S.R.)

18697

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

PROYECTO RA2—VALVULA DE DESCARGA. MECANISMO DE ACCIONAMIENTO. Informe No. 19. (Project RA-2. Discharge Valve. Mechanism of Operation. Report No. 19). Erico Spinadel. 1959. 6p.

The mechanism operating the discharge valve of the RA-2 Reactor is sketched. It is designed to be simple and compact, to be safe from current failure, to be safe from overpressure in the open valve, to prevent the valve from being closed when there is no water in the core, and to prevent the closing of the valve before complete discharge. (J.S.R.)

18698

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

COMANDO DE BARRAS DE CONTROL Y SEGURIDAD PARA EL REACTOR EXPERIMENTAL RA-2. Informe No. 23. (Operation of the Control and Safety Rods of the RA-2 Research Reactor. Report No. 23). Erico Spinadel. 1959. 6p.

The apparatus used to operate and monitor the control and safety rods of the RA-2 Reactor is sketched and briefly described. (J.S.R.)

WASTE DISPOSAL AND PROCESSING

18699 AECL-990(Paper 13)

Atomic Energy of Canada Ltd., Chalk River, Ont.

MANAGEMENT OF RADIOACTIVE WASTE. C. A. Mawson. Paper 13 of SYMPOSIUM ON EQUIPMENT MANUFACTURING AND DEVELOPMENT PROBLEMS FOR NUCLEAR POWER SYSTEMS, CHALK RIVER, ONTARIO, APRIL 19-20, 1960. 8p.

The management of gaseous, solid, and liquid waste is discussed relative to experience at Chalk River. (W.D.M.)

18700 CF-59-10-124

Oak Ridge National Lab., Tenn.

REACTOR COOLANT DECONTAMINATION: A LITERATURE SURVEY. J. C. Mailen. Oct. 30, 1959. 34p. OTS.

Literature on reactor coolant and coolant loop contamination and decontamination was reviewed. The survey covered the four main reactor coolant types (water, gas, organic, and liquid metal) and both activated corrosion products and fission product from leaks. The mechanisms and rates of deposition of the various materials in the various coolants were compared. Various chemical decontaminating solution compositions and procedures were collected and presented. (auth)

18701 HW-62844

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DECONTAMINATION OF THE KER RUPTURE EXPERIMENT LOOP. TEST SERIES B—TEST NO. 3, TEST SERIES D—TEST NO. 1. R. D. Weed. Nov. 25, 1959. 14p. Contract AT(45-1)-1350. OTS.

The Bettis COD(S-4) decontamination process is compared to a Turco-Wyandotte combination decontamination process. Average specific decontamination factors and average total specific corrosion penetration are used for the comparison. The corrosion of stainless steel was of the same order of magnitude for both processes but carbon steel corrosion was higher by a factor of 10 with the Bettis process. The decontamination factors were higher in all cases with the Turco-Wyandotte combination process. Data are tabulated. (auth)

18702 HW-63916

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

ONCE THROUGH DECONTAMINATION STUDIES. Interim Report No. 2. Lyle D. Perrigo and J. F. Hokenson. Feb. 18, 1960. 8p. Contract AT(45-1)-1350. OTS.

A report on efficiency of citric acid and decontaminating agents composed of oxalic acid and phosphoric acid or sodium bisulfite for KER loops and contaminated coupons and an efficiency of inhibited phosphoric acid for high-temperature contaminated films are presented. Data and conclusions are given. (J.R.D.)

18703 NYO-4444

Massachusetts Inst. of Tech., Cambridge. Sedgwick Labs. of Sanitary Science.

THE FIXATION IN VITREOUS MATRICES OF HIGH ACTIVITY FISSION PRODUCT WASTES FROM AQUEOUS REPROCESSING OF SPENT STAINLESS STEEL—URANIUM FUEL ELEMENTS. Morton I. Goldman, T. H. Y. Tebbutt,

A. R. McLain, Byung C. Kim, and Rolf Eliassen. Feb. 1, 1960. 204p. Contract AT(30-1)-621. OTS.

The fixation of high activity fission product wastes from the reprocessing of spent stainless-steel fuel elements by firing with lime and sand to a glassy state was investigated. Volume reduction factors as high as 32.8 were obtained. The glass immobilized as high as 70% by weight of calcined waste oxides. Leaching rates of Cs^{137} from these vitreous matrices by boiling distilled water ranged from 7.7×10^{-6} to 4.8×10^{-5} cm/wk, expressed as corrosion rate of glass. The corrosion rate decreased for strontium, iron, and zirconium, in that order. Zirconium-based corrosion rates ranged from 8 to 16×10^{-8} cm/wk. Composition parameters had a relatively small effect on the corrosion rates in comparison with the effects introduced by firing conditions; both underfiring and slow-cooling of the fusions increased the cesium corrosion rates by significant amounts. Electron beam irradiation of selected samples to a dose of 10^{10} rad generally had a small effect on the corrosion rates. Cesium was lost from the fusions during the firing process in amounts ranging from 0 to 66% of the original cesium present. At temperatures below 1450°C, the cesium lost from the glass was apparently retained in the clay crucible and lid. No cesium was lost during evaporation and denitration of the liquid waste at temperatures up to 800°C. Assuming that crucibles and their contents will be stored in underground vaults, preliminary calculations indicate that cooling with air by natural convection is feasible with glass heating densities below about 2000 Btu/hr-ft^3. The cost of waste processing by glass formation and storage would approximate 0.1 mills per kwh of electrical energy produced. (auth)

18704

RADIOACTIVE WASTE PRODUCTS. VI. PROBLEMS OF FINAL STORAGE. Th. van der Plas. Atoomenergie 2, 70-8(1960) May. (In Dutch)

A survey is made of the present ideas on the final storage of radioactive wastes. Very active wastes (10 to 100 c/l), average active wastes (0.1 to 1 c/l), and slightly active wastes with a large volume and low activity are considered in succession. Attention is especially given to future possibilities in the storage of radioactive wastes. (tr-auth)

18705

DESIGN OF CONTAINERS FOR STORAGE OF RADIOACTIVE EFFLUENT WATERS. L. Tihanyi. Epuletgepeszet 7, 199-202(1958). (Translated from Referat. Zhur. Khim. No. 23, 1959, abstract No. 82710).

Formulas and a nomogram for container design are presented.

18706

DISPOSING OF RADIOACTIVE WASTES BY FIRE. R. F. West (Incinerator Co. Ltd., London). Ind. Rev. Africa. Suppl. Atomics and Energy 11, No. 10, 98(1960) Apr.

A method is proposed for the disposal of radioactive wastes by incineration. The main considerations governing the design of an incinerator are discussed. The handling methods during incineration are outlined. The combustion chamber is designed for simultaneous end-firing of both liquid and solid wastes. To ensure that no radioactive particles can possibly reach the atmosphere by way of the flue, the furnace is provided with a "centrifugal" water-trough dust-catcher and multispray gas scrubber. (B.O.G.)

18707

PROCESSING AND LOCALIZATION OF RADIOACTIVE WASTE OF NUCLEAR REACTORS. VDI Zeitschrift 102, 618(1960) May 21. (In German)

Chimneys of reactor buildings were discussed, and a design is recommended to eliminate suction effects which could lead to a deposit of the radioactive substances in the vicinity of the chimney. (M.C.G.)

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